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OF THE

DEFENSE SCIENCE BOARD

TASK FORCE

ON

JOINT PRECISION INTERDICTION

JUNE 1994

Office of the Under Secretary of Defense for Acquisition
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DEFENSE SCIENCE BOARD

MEMORANDUM FOR UNDERSECRETARY OF DEFENSE (ACQUISITION AND TECHNOLOGY

Subject: Report of the Defense Science Board (DSB) Task Force on Joint Precision Interdiction

I am pleased to forward the final report of the DSB Task Force on Joint Precision Interdiction (JPI). The Task Force was co-chaired by Dr. Eugene Fubini and Mr. David Heebner and conducted an appraisal of the technologies and supporting programs in place to carry out the JPI mission.

The work of the Task Force drew on several years effort of the DSB Task Force on Follow-On Force Attack (FOFA) in which emphasis was placed on evaluation of the risk associated with developmental sensor and weapons technologies. As the developing technologies proved themselves in successful sensor and weapons systems the issues of interest became, "How should these systems be applied in warfare scenarios?" and, "Are our acquisition plans likely to equip US forces to employ the new systems effectively?" EUCOM did pioneering work in developing operational concepts and mission definitions relating to the application of new systems under the name Joint Precision Interdiction. These concepts led to the tasking of the JPI Task Force. The Task Force did its work in close cooperation with CINC EUCOM (Gen. James McCarthy) and his staff.

The Task Force found that planning for the acquisition of the sensors and weapons were well structured though resulting in a slower introduction into the Services than one might prefer. However, major difficulties were identified relating to the information systems and command and control and intelligence systems required to implement the JOINT application of JSTARS, Battlefield Intelligence Systems, Precision Guided Weapons and Smart Munitions. This finding is, of course, consistent with that of the Tactical Air Task Force in its Summer Study of 1993.

The Task Force recommends that OSD continue to provide focused leadership to keep all elements of this complex of development and acquisition activities in balance and, especially, to guide the development and implementation of an information architecture capable of providing real time command and control of Joint use of precision weapons systems.

Paul G. Kaminski

Paul G. Kaminski
Chairman
Defense Science Board

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DEFENSE SCIENCE
BOARD

MEMORANDUM FOR CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Report of the Defense Science Board (DSB) Task Force on Joint Precision Interdiction (JPI)

Attached is the final report of the DSB Task Force on Joint Precision Interdiction (JPI). This report responds to tasking by the Joint Chiefs of Staff and the Secretary of Defense to conduct an appraisal of the status of technologies and supporting programs to carry out the JPI mission. This work builds on a long period of DSB work in support of the Follow-On Forces Attack mission developed by SACEUR during the Cold War Period. The JPI Mission was formulated by EUCOM at the end of the Cold War and was focused on dealing with highly maneuverable forces in a situation characterized by ill defined battle lines and highly permeable frontiers that has been called "the non-linear battlefield". While Cold War confrontation is no longer our model for combat planning, it is being replaced by Regional Conflict models and engagement scenarios that retain the fundamental characteristics of highly mobile forces and permeable frontiers. In these scenarios, the term Joint Precision Strike is used and is a direct and very important evolution from JPI concepts. The weapons systems and technologies that were intended to implement JPI are equally applicable to the new situation.

The appraisal of JPI relevant technologies shows that there are (or have been) many very successful developments that provide implementations of the battlefield intelligence, target acquisition, weapons delivery systems, munitions and battle damage assessment functions required for JPI. However, the information systems and interoperable communications needed to tie the system elements together in the JOINT operational environment are lacking and obtaining such capabilities has been a persistent problem. It is recommended the OSD continue to place its emphasis on the compatible information systems aspects of developing Joint Precision Interdiction (and/or Strike) capabilities. It is further recommended the OSD provide focused leadership to keep all elements of this complex of development and acquisition activities in balance.

As Joint Exercises refine the tactical employment of these systems and continuing technology efforts serve to drive down the costs of the system elements, we believe the principles of the application of military power through improved real time battlefield intelligence and precision munitions will become the model for tactical warfare of the future.

David R Heebner

David R Heebner
Chairman

DEFENSE SCIENCE BOARD

JOINT PRECISION STRIKE TASK FORCE

FINAL REPORT

June 1994

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EXECUTIVE SUMMARY

This Defense Science Board (DSB) Task Force was charged in July 1991 to examine Joint Precision Interdiction (JPI), review systems and developments, and recommend system improvements. Since that time, the Task Force has concluded its three-phase program, the results of which are included in this report.

In Phase I, the Task Force invited Theater Commanders-in-Chief (CINCs) to provide operational insights into the utility and application of JPI. The Task Force learned that JPI is an operational concept that recognizes and responds to the realities of the Post Cold War era, and is designed to exploit the United States' competitive technological advantage. The CINCs with whom the Task Force met with unanimously supported the JPI concept on operational grounds and its incorporation into our forces as quickly as possible. CINC EUCOM (European Command) and CINC UNK (United Nations Command-Korea) were especially helpful in developing our understanding of the military issues driving the utility of JPI and our appreciation of the importance of rapidly implementing force capabilities to carry out the JPI mission. Through our interactions with the CINCs we also gained an appreciation for the applicability of the "JPI systems" to military functions beyond the strict limits of JPI.

JPI is an Alliance concept of operation that was developed by SACEUR (Supreme Allied Commander, Europe). In its simplest form, it is intended to create a substantial maneuver differential for Allied forces which are expected to be mobile but small in size, and which will operate on a low density conventional battlefield. It emphasizes attacks by air and missile means and advantageously employs the "system of systems" developed for FOFA.

The major differences between FOFA and JPI lie in the circumstances which attend a much lower force-to-space ratio and the elimination of shorter range battlefield nuclear weapons. FOFA was principally intended to break momentum with conventional means and as a result, reduce dependence on an early resort to nuclear use. JPI is intended to provide the circumstances for conventional superiority flowing from maneuver advantages.

In addition to the views of key military leaders, we have had the experience of the Gulf War, the use of Tomahawk missiles against the Baghdad intelligence complex, in-depth analyses of the effectiveness of smart weapons used in combination with highly accurate and timely targeting information, and the DSB review of Tactical Air Warfare. All of these strongly reinforced our assessment that the types of sensors, weapons, C^3I, mission planning and execution systems defined for JPI together constitute a revolutionary step in the development of warfighting capability. Our assessment is that the investment made to date in these capabilities can have enduring value, and that the process of ultimately putting these capabilities into each Service inventory is of critical importance.

In Phase II the Task Force reviewed JPI-capable systems under development and in U.S. service inventories. The development and acquisition process from which most of the systems evolved was initially intended to meet the needs of the Follow-On Force Attack concept developed by SACEUR. Fundamental to that concept was a "system of systems" driven by very short response times and the precision delivery of military power to prevent second echelon and other reinforcing forces from arriving in the battle area at the Inter-German Border (IGB). These concepts evolved into Joint Precision Interdiction and retain the idea of a "system of systems." This approach offers the opportunity to develop and procure elements of JPI systems within a trade-off context wherein advancements in one area may obviate or reduce requirements for expensive or difficult advancements in another. For example, the use of brilliant, wide-footprint submunitions reduces the

requirement for precise target location for some classes of targets. To realize any value from such systems trade-offs, it is necessary that someone have the knowledge and authority to implement them across Service lines; the fairly complex information network required to make a "system of systems" work be architecturally sound (in a systems sense); and, the necessary disciplines be in place to assure that separately developed system and sub-system elements will work together. At present no assurance is evident that such a system oversight capability exists. Likewise, neither is there any evidence of system interoperability disciplines adequate to the challenge. The Task Force view these missing elements as the most serious challenges to implementing JPI capabilities, as well as satisfactorily applying the technologies more generally to Strike Warfare. (They are not, by any means, the only challenges to satisfactory implementation.)

In addressing the utility and effectiveness of the FOFA architecture and hardware suite in supporting JPI needs, EUCOM, SHAPE and the JCS were really inquiring into the future value of the $50 Billion FOFA investment. Our assessment, the views of the CINCs and the operational experience in the Gulf War all reinforce a very positive answer to the utility and effectiveness questions, not only for JPI, but also for a variety of theater and contingency operational concepts. The investment has an enduring value.

Four years ago, the Task Force summary judgment was that the FOFA suite was worth the cost and the development risk because, if deterrence failed, resulting military capabilities would reduce substantially U.S. and Allied dependence on an early resort to nuclear use. Today, the Task Force judges that the FOFA suite is fully worth the remaining acquisition cost and that its architectural and hardware/software robustness will assure its value in a broad spectrum of possible future contingencies and scenarios. These same qualities offer cost effective P^3I opportunities which we believe will maintain the former FOFA system suite as a key element in establishing new forms of deterrence and dissuasion and underwrite new concepts of operation for combat circumstances.

In the course of its review the Task Force identified a number of developments in JPI-related technologies, particularly in sensing and stand-off attack, that have great potential for improving JPI capabilities. A great number of technology developments have potential application for this purpose. Enumerated here are just a few of the items that apply to RSTA, to C^3I, to weapons and weapons platforms and to the support required for mission execution.

Reconnaissance, Surveillance and Target Acquisition. The ability to widely disseminate near real-time (NRT), wide area Moving Target Indicator (MTI) information dramatically improves JPI capability. This improvement can be maximized through proliferation of ground stations.

• Synthetic Aperture Radar (SAR) provides high-resolution, all weather imaging. Improvement in this capability can be achieved in two areas: rapid dissemination, similar to MTI dissemination, and either training imagery interpreters or developing automatic target recognition capability.

• The utility of SAR with MTI history, as done in the Joint Surveillance Target Attack Radar System (JSTARS), is a powerful aid to data interpretation. This type of correlation should be pursued along with other SAR sources. SAR utility may be enhanced by sending imagery to appropriate Ground Station Modules (GSMs) or, alternatively, by integrating Surveillance and Control Data Link (SCDL) into the SAR ground station.

• High accuracy, targeting-quality signals intelligence (SIGINT). The technology is available; however, security barriers to its timely dissemination persist.

Command, control, and communications (C^3). The technology exists now to provide broad access to large amounts of data through broadcast mechanisms. NRT insertion into the data stream of information from multiple and varied sources could become routine. Barriers to implementation are cultural.

Weapons/Platforms. Accurate delivery at extended ranges and smart/brilliant submunitions are available. However, the preponderance of U.S. munitions, such as those used during Desert Storm, fall into the category of "short/no stand-off." The bulk of air-delivered munitions have insufficient range to provide stand-off for survivability.

Mission planning. This is the pacing function for JPI timeliness. Timely Mission Planning is critical to many of the targets in the likely JPI Target Set. The ability to sense a critical target and to subsequently destroy that target hinge on the planning function to get the right platform and munition to the target before movement or other countermeasures render the target survivable. Significant emphasis should be placed on improving the mission planning element of JPI.

Throughout the Task Force report, specific conclusions and recommendations are made relative to the subject under discussion. Extracted below are the major conclusions and recommendations, some of which are repeated in the text. Not included here are conclusions and recommendations concerning classified programs. These are included in an appropriately classified supplement to the report.

Technologies to be Pursued

Technologies to be pursued in the further development of JPI fall into two categories:

- Broadly leveraging, and
- Specific to RSTA, C^3 and Mission Planning, and Weapons/Platforms.

There is a single candidate technology which is indeed broadly leveraging because it influences all specific subcategories and areas beyond these. It is automatic target recognition (ATR) in its numerous manifestations.

Substantial research effort is warranted because success in fielding ATR and ATR-aided capabilities will improve the effectiveness, efficiency, timelines and discrimination in RSTA, C^3, and weapons and materially change (for the better) the complexities and manpower intensity of mission planning.

Currently and contemplated Technology Demonstration (TD) programs which feature ATR as a key element should be evaluated in a larger framework and restructuring should be done to minimize the principal past inhibitor to progress in this area, namely - too many poorly funding programs which had little chance of succeeding.

The fielding of true ATR capabilities has the potential to revolutionize a broad spectrum of military capabilities.

Conclusions

1. The ideas embodied in JPI are very important to the development of tactical warfare and may be revolutionary in the same sense that stealth has proved revolutionary.

2. The technologies required are largely (but not totally) available.

3. The joint aspect is critical to success, both operationally and systems-wise; however, the necessary level of joint activity is lacking and getting worse.

4. A consistent weapons system architecture (by this we really mean interoperability) is needed and is not in place.

5. Data communications from targeter to shooter is required.

6. Exercising system elements alone and in combination with other system elements is needed in joint exercises. These exercises should use actual equipment in realistic scenarios to test timeliness and interservice coordination.

7. Networked simulation is an attractive tool for developing tactics and exercising JPI systems.

8. The pace of bringing smart weapons into the inventory is too slow and will limit our ability to carry out JPI missions beyond the turn of the century.

9. Credit is due the Air Force for accelerated acquisition of SFW and JSTARS.

10. Credit is due the Army for its efforts to keep ATACMS/BAT a viable program and its successful efforts to tie GSM to JSTARS.

11. Credit is due the Navy for its interest in applying MLRS/ATACMS in littoral warfare scenarios.

Recommendations

1. Provide strong leadership from OSD to all aspects of JPI system development and acquisition. This leadership must be able to tie together the information system aspects of JPI systems with the sensor, weapons, platforms and munitions projects.

2. A long term technology program should be set up to introduce new technologies into JPI (and Strike) systems as they mature. Particular attention should be directed to terminal guidance techniques, automatic target recognition, networked data communications, UAV applications and wide area surveillance.

3. JCS sponsored exercises should continue to emphasize joint operations, particularly to refine operational concepts for JSTARS targeting for Army and Navy strike systems; to integrate intelligence sensor derived information into the real-time targeting function; and, to integrate mission planning processes as needed to accomplish coordinated use of all Service strike weapons systems.

4. OSD and JCS should work together (and with the Services) to create a networked simulation capability to allow exercises using physically separated forces as well as exercises using a mix of real and simulated force capabilities. A good start toward this goal has been made under the aegis of the Joint Precision Strike Technology Demonstration program. Broader service participation is needed.

5. As pointed out in the DSB study on Tactical Air Warfare, acquisition of weapons and munitions required for JPI and Precision Strike must be expeditious. Procurement of such weapons as SFW, JDAM, JSOW, etc., should be paced by the best timeline each development program can achieve.

6. Common grid navigation accuracy for JPI systems is provided by GPS. Additionally, some of the weapons delivery options will take advantage of the precise measurements possible with GPS. These uses of GPS make the precision in JPI and the timeliness of strike operations dependent on the continuous availability of GPS signals. A concern about the jamming vulnerability of GPS has been raised in other contexts, and such vulnerability is of particular concern to JPI systems. Careful investigation and a search for countermeasures to possible GPS jamming is critical.

In November 1993 the Task Force responded to a speech by the Secretary of Defense on the subject of U.S. military force abilities to deal with two regional contingencies simultaneously. In this response a number of points were made which are applicable here. Our concern is that planners may be assuming that much more of the capability to deliver precision strike and interdiction power exists than is actually in place (or will be in place under present acquisition and development plans.)

"1. The dates for initial and full operational capability are years away, although some of the building blocks are or can be made available in limited quantities.

2. There is insufficient joint capability in that not all Services have comparable, complementary, or interoperable capabilities.

3. There are integration and information shortfalls.

4. Several P^3I programs should have greater priority for accelerated fielding for this mission.

5. If there is (or arises) a need for accelerated fielding, this could be done with several systems."

The JPI Task Force fears we are losing precious ground in our effort to achieve a major (perhaps revolutionary) improvement in our ability to conduct tactical warfare.

JOINT PRECISION INTERDICTION (JPI)

1.0 BACKGROUND

The Joint Precision Interdiction (JPI) Task Force was established in July 1991, sponsored by the Joint Chiefs of Staff (JCS), Supreme Headquarters, Allied Powers Europe (SHAPE) and U.S. European Command (EUCOM.) The Task Force focused on the operational application of the systems that had been developed for Follow-On Force Attack (FOFA) and Air-Land Interdiction Missions. When the Task Force was initiated, EUCOM proposed a doctrinal approach to such operations in the form of a Joint Precision Interdiction Doctrine paper. The ideas offered in that paper were subsequently incorporated into a broader doctrinal publication, Joint PUB 3.0, JCS Pub on Joint Operations. JCS PUB 3.0 has been approved and promulgated. Although the doctrinal issues associated with joint precision interdiction have been addressed, related interservice issues remain unresolved. Also, a clear path to developing and fielding a set of sensors, weapons and delivery systems that can function in a joint operational environment is not evident. The JPI Task Force final report addresses the systems, their status of development and acquisition, the information environment necessary to effectively employ these systems, and the joint arrangements CINCs will require to get full value from the combination of sensor weapon technologies that are becoming available.

The DSB FOFA Panel was the principal forerunner of the JPI Task Force. Follow-On Force Attack was an operational concept generated by General Rogers, Supreme Allied Commander, Europe (SACEUR), to stem the flow of reinforcing echelon forces into the forward battle area in the event of an attack on the thinly developed NATO forces along the Inter-German Border (IGB) and on the NATO flanks. New technology promised the ability to detect and destroy moving armor in the enemy's rear. This capability would (1) buy time for western reinforcing forces to get into place, and (2) delay the time at which NATO would be forced to use tactical nuclear weapons to defend against massive force concentrations. The technologies included smart anti-armor weapons, airborne synthetic aperture and ground moving target indicating radars, missile and penetrating aircraft delivery systems, and very quick reacting mission planning and command and costs of structures. Since these technologies lent themselves to Air Force structure in some cases, and Army structures in other cases, it was clear that only highly coordinated joint operations would use them effectively.

The role of the FOFA Panel, during the period 1982 through 1987, was to evaluate the technical risks in developing programs that would apply the new technologies; to help in refining concepts for the application of the technologies; and, to look for gaps or incompatibilities that might impede the realization of the ability to carry out FOFA in the NATO environment.

The FOFA Panel reported its work in a series of letter type reports which dealt with specific issues as each was addressed. Many of these reports were prepared under caveats that severely limited their distribution. These restrictions on distribution were necessary at the time to protect the programs and technologies involved. These FOFA reports were an important background resource for the JPI Task Force and they provided valuable inputs to the continuing evaluations of technical risks as they applied to the surviving systems and programs.

With the decline and final demise of the Soviet threat, emphasis on FOFA in the NATO environment disappeared. These and other changes led to a rethinking of U.S. defense posture and resulted in the evolution framework of Regional Scenarios. While none of the Regional Scenarios established the threat concentration and immediacy of the

"NATO Scenario," the Regional Scenarios offered formidable challenges. The nature of these challenges included substantial armored threats, very short reaction timelines, and often very long lines of logistic support.

The Gulf War provided an opportunity to apply some JPI systems in an operational situation. While still in a developmental phase, the Joint Surveillance Target Attack Radar System demonstrated the value of looking deep into enemy territory, finding moving targets, and communicating this information on a real time basis. Smart weapons demonstrated the ability to efficiently kill high value targets. Low visibility "stealth" vehicles demonstrated the ability to penetrate air defenses and strike hard targets with precision. National technical sensor-derived information was exploited for tactical purposes on a timely basis. All of these capabilities were orchestrated and employed through information networks that were created on an ad hoc basis and staffed with people borrowed from other functions. Importantly, the effectiveness of this combination of military tools proved exceptional and, together with other forces, was able to successfully carry out missions with a very limited number of friendly casualties and a minimum of collateral damage to the enemy. These results have strongly encouraged our pursuit of JPI systems from development through fielding, including the development of an information system structure and command and control apparatus for timely provision of target data to weapons. Additionally, development of joint operational relationships, systems, training and exercises is needed to make genuinely joint operations a familiar and tested practice rather than an ad hoc arrangement put together at the last minute.

The material that follows identifies: areas that require DoD management attention, some technical risks, needs for training and exercising of these complex systems and organizations, and the urgent need to acquire a set of capabilities for our armed forces and adequately proliferate these capabilities within the U.S. military community.

1.1 TASK FORCE ASSIGNMENT

The DSB Task Force on JPI is sponsored by Headquarters, United States European Command. General James McCarthy, Deputy Commander in Chief, USEUCOM, charged the Task Force with reviewing acquisition strategies for surveillance, reconnaissance, target acquisition, command, control, and communications (C^3) as well as weapons platforms and munitions. He directed that these acquisition strategies be viewed in light of a number of factors: ranges of conflicts; spectrum of targets; enhancement of surveillance systems including National Technical Means (NTM); joint and combined applications; all theater CINCs' needs; and, new emerging technologies.

In a letter to the DSB, the Chairman of the Joint Chiefs of Staff, General Colin Powell, amplified the Task Force's mission. He asked the DSB to review the Follow-on Forces Attack technologies to determine if they were appropriate for the post-Cold War era.

The Task Force interviewed key commanders and warfighting CINCs, including General Von Sandrardt (former Allied Force Commander Central Europe,) the commander of the Army Training and Doctrine Command (TRADOC), and the commander of the Air Force Air Combat Command (ACC - formerly Tactical Air Command [TAC]). Additionally, a review of pertinent technologies was conducted.

1.1.1 Chairman's Tasking

The Chairman's Tasking has been classified by the Director, J-7 and is included under separate cover in the classified annex, Appendix B.

1.2 STUDY APPROACH

The Task Force adopted and completed a three-phased study approach.

In Phase I, the Task Force received/reviewed information on the JPI concept and the views of the theater CINCs and Services on JPI.

In Phase II, the Task Force received/reviewed information on current and near-term systems with applicability to JPI, and made preliminary assessments.

In Phase III, the Task Force reviewed system architectures, assessed developmental future JPI capabilities, and developed recommendations for research and development courses of action.

Sections 2.0 through 5.0 of this report address the Task Force's appraisal of the basic elements of JPI: Reconnaissance, Surveillance and Target Acquisition (RSTA); C3; Mission Planning; and, Weapons/Platforms. The Task Force reviewed the JPI requirements for and capabilities of each of these elements, as well as assessing each element. In section 6.0, Task Force recommendations relevant to each element are presented.

1.3 JPI MEMBERSHIP/CONTRIBUTORS

The Task Force membership is shown here.

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The Task Force is privileged to have the support and advice of a number of military leaders, notably CINCs and senior Service officials. An important contribution was made by the recently-retired CINC, Central Europe, General Von Sandrardt. Their participation emphasizes the importance they attach to achieving a JPI capability.

The demand for and direction of JPI flows from the CINCs.

1.4 JPI - DEFINITION

JPI is a theater warfare concept. It was developed to meet changed conditions in the world utilizing the advantages of recent military technological advancements and focuses on regional concerns.

JPI recognizes a set of new realities; these include substantially smaller forces, the likelihood of distant deployments, and the absence of a forward, linear defense.

JPI was first postulated by General John R. Galvin, Supreme Allied Commander Europe, to contribute to developing a maneuver differential for NATO. In his explanation of JPI, he stated that the maneuver differential would be accomplished both by obtaining and protecting a high degree of mobility and by inhibiting the enemy's mobility. This capability was called "Joint Precision Interdiction." The other theater CINCs quickly realized the application of this capability to their theaters, as did the JCS.

JPI's key elements are the ability to sense the enemy at operational depths and to understand his operation; to select and prioritize attacks on the enemy which will best

ensure success of the Joint Force Commander's (JFC) scheme of maneuver; and to execute those attacks effectively, synchronizing them in time and space.

There is only one aspect of JPI that is totally new. Successful commanders have always employed a variety of techniques to achieve the mobility differential described by General Galvin. The new component is the availability of advanced technology systems which, for the first time, allow commanders to have continuous wide-area surveillance (WAS) and target acquisition, NRT responsiveness, and highly accurate, long-range weapons at their disposal.

1.5 JPI STATUS

JPI is widely supported by the warfighting CINCs. In fact, it is a key operational concept in both Korea and Europe. The Supreme Headquarters, Allied Powers Europe has identified JPI as an area of emphasis in the new, emerging military guidance for NATO. U.S. Central Command (CENTCOM) recently demonstrated JPI in Desert Storm when it employed JSTARS to watch its right flank, which it boldly exposed during the famous "left hook." Without the ability to know when or if that flank was threatened, CENTCOM would have had to use at least a division for flank security. Additionally, during the "mother of all retreats," CENTCOM employed the Army Tactical Missile System (ATACMS) to interdict and immobilize the retreating column, allowing tactical air (TACAIR) to destroy it. Both are good examples of JPI.

The "jointness" required for successful JPI, which has been accomplished without difficulty in the field, remains a challenging concept for the Service staffs to accept. The Joint Staff initiated a Joint Publication on JPI - Joint Test Pub 3-03.1. This publication was subsequently canceled. Yet, JCS Pub 3.0 on Joint Operations has been published and a proposed JCS pub, Doctrine for Joint Interdiction Operations, will be in print in January or February 1994. This proposed publication incorporates the concepts contained in the canceled document on Joint Precision Interdiction.

1.6 OPERATIONAL OVERVIEW OF JPI

The Task Force's mission was to assess and review acquisition strategies for technologies contributing to a JPI capability. The first phase involved understanding the requirements and concept of JPI. JPI is intended as an integral operation of a Joint Force Commander's theater campaign. It has evolved from a convergence of changes in the world security environment and warfighting operational concepts, a revolution in technological capabilities, and insights derived from associated war fighting analyses and Operation Desert Storm. This section summarizes those changes and insights; together, they provide the rationale and requirement for JPI operations. Additionally, they have shaped the Task Force's views regarding JPI's objectives and requirements

1.6.1 Changes in the World Security Environment

For nearly fifty years, the world political/military environment was dominated by the bipolar relationship between the Soviet-led Warsaw Pact and the NATO Alliance. During these years, the Pact maintained a significant numerical advantage in conventional forces over NATO, causing NATO to rely on nuclear deterrence against a massive Soviet offensive. To offset this force imbalance, U.S. defense budgets increased significantly to modernize the military over the last decade. Concurrently, NATO developed the Follow-On Force Attack concept to raise the nuclear threshold by developing a conventional capability to find and attack the Pact's maneuver forces at deep ranges.

During these years, the Soviets exerted significant influence over several Third World countries' military activities via economic means, technology controls, and subtle military pressure. Although several regional conflicts occurred, during which there was concern about escalation, there was a general understanding of the international rules and, in retrospect, it was a relatively stable global environment.

Several events and activities occurred over the past three years that have led to a radical change in the European, global, and national security environment:

- The Conventional Force Reduction in Europe (CFE) talks and resultant treaty were the first step in eliminating the major force imbalance in Europe. The demise of the Warsaw Pact, the collapse of Soviet communism, and the dissolution of the Soviet Union further reduced the threat to NATO and led to unilateral reductions by the non-U.S. NATO allies.

- NATO force restructuring, resulting in more multinational forces and the Rapid Reaction Force, led to new operational concepts for employment on a nonlinear battlefield.

- Deep and continuing cuts in U.S. Defense spending have become a reality.

- U.S. strategy has changed to "forward presence," with more Continental United States (CONUS)-based forces and revised operational concepts to reflect a more proactive and power projection orientation.

- The global economic environment has changed dramatically: The former Soviet Union is in economic disarray, American economic leadership has lessened, Japan has demonstrated its ability to influence financial markets, the German economy is rapidly expanded but has recently suffered some setbacks (post-unification), oil has increased the wealth of many Gulf nations, and a number of East Asian nations are making substantial industrial progress.

- Modern technology is available to all nations.

- The Gulf War verified modern technology's importance and stimulated changes in the U.S. defense strategy.

- A new U.S. National Military Strategy (NMS) was created, emphasizing regional conflicts and crisis response, with a concomitant draw down of overseas forces and emphasis on power projection for contingency operations ("come as you are" wars). The NMS highlights joint requirements to support coalition partners and codifies the new military success criteria: decisive force, swift victory, minimum casualties.

- A new defense acquisition policy was developed, emphasizing science and technology to maintain the current U.S. technology leadership, resulting in fewer new system starts and less procurement.

These events have already produced a dramatically different global security environment. It is an economically multi-polar world and militarily uni-polar world that is more disorderly, more unstable, and more uncertain, with an increased likelihood of Third World conflicts. As the 21st century approaches, this environment is expected to change even further with the anticipated major revolution in military technology. The degree to which the U.S. maintains its technological lead is at the heart of the topic addressed by this report.

1.6.2 Evolution of Operational Concepts

An operational concept is the means of applying military forces by a senior commander to prosecute a war and the mechanism for implementing a theater campaign strategy. It is developed by the CINCs for their specific theaters and by military planners in CONUS. These concepts have evolved due to changing operational needs in the new global security environment and in anticipation of new technologies. The need for JPI stems from the evolutionary changes in warfighting operational concepts described below.

In the late 1960s-1970s, NATO's "trip wire" strategy was replaced by the "forward defense" strategy. As a political imperative, NATO's main defensive forces were focused on defending and maintaining territory. They were positioned in a somewhat linear fashion along the Inter-German Border (IGB), defending the expected main avenues of approach. These forward-deployed forces performed the bulk of surveillance and reconnaissance missions to determine the location of the enemy's main attack. The Warsaw Pact was expected to attack in particular sectors of the IGB with sufficient mass and velocity to saturate and overwhelm NATO's defensive capability in those sectors, and then penetrate to the west. Because of the IGB's length and the force positioning along it, many of NATO's forces could not engage the enemy's main attack. Active defense, embedded in the forward defense operational concept, was designed to alleviate the saturation effect by using killing zones and mobility to delay the enemy and inflict maximum attrition on him in NATO territory.

In the late 1970s-early 1980s, AirLand Battle (ALB) doctrine replaced active defense in the U.S. Anticipating technology developments in the U.S., it focused on defeating enemy forces rather than on defending territory. NATO's forward defense concept started changing in the early to mid-1980s. Although the political climate still required an orientation on territory, FOFA replaced active defense in NATO. FOFA was designed to alleviate the saturation effect in the linear battlefield without trading ground for attrition. Assets capable of doing so would attack uncommitted second echelon Soviet forces to delay, disrupt, divert, and destroy them in Warsaw Pact territory.

Given the dramatic changes that have taken place, military planners in the U.S. and Europe have been evolving/designing new concepts for operating on a nonlinear battlefield. This battlefield involves fewer forces and more territory, (with a reduced force-to-space ratio), more mobility, and simultaneous deep and close operations. The JPI concept recognizes the changed situation and recognizes the role of technological advances in responding to the change. It is the concept for the post-Cold War period. It will allow the "overmatch" that our current NMS demands.

Several key changes are inherent in JPI. The theater CINC/JFC is the implementing authority. Scarce resources are retained at the "corporate" level for centrally controlled commitment. High technology sensors replace forward units as the principal surveillance and reconnaissance means, precisely acquiring the enemy for leveraged attack. The concept focuses on concentrating fires, not just forces, and places a premium on mobility. Deep attack is used to attack enemy centers of force concentration.

The new concept has a proactive and offensive orientation. To seize the initiative early in the campaign, deep strike/deep attack is focused on the enemy in his territory. Deep strikes are intended to shape the battlefield. Deep strike activities are also intended to weaken enemy forces through attrition before committing maneuver forces. The concept envisions continuous activities of detecting the enemy, preparing for battle, establishing conditions for maneuver engagement, winning the close combat engagements, and reconstituting.

The concept also envisions simultaneous deep and close operations. In a contingency conflict with entry required during an enemy's attack operations, the new concept may require simultaneous air superiority, fixed wing air interdiction, Army deep attack, and Naval off-shore deep operations to ensure decisive victory.

Successful use of JPI at the operational level is inhibited by two factors. The ability to conduct JPI is relatively new, and few commanders and staffs are trained or have experience with JPI operational-level training. JPI has not been incorporated into most exercises.

To be able to employ JPI successfully in the future, commanders and staffs must receive the necessary opportunities to learn and understand this operational concept, as well as its associated weapons and systems, in exercises conducted in a variety of circumstances.

JPI training should be emphasized in theater-level exercises over the next several years. This should be done by combining reality and simulation where possible.

1.6.3 Revolution in Technological Capabilities

New operational concepts, especially JPI, have evolved in part because of changes in the global security environment. They have also evolved because new technologies have emerged that provide the fundamental capabilities needed to implement the concepts. Some of the key relevant technologies are:

- Sensor systems for broad area surveillance/reconnaissance and precision targeting under all environmental conditions (day/night, all weather);
- Security/countermeasure systems;
- Data processing and communications;
- Delivery systems;
- Precision munitions; and,
- Position/location devices.

These technologies can facilitate full and rapid U.S. implementation of JPI operational concepts worldwide.

1.7 JPI CONTRIBUTION

The equipment and materiel being developed to make JPI a possibility can be applied beyond JPI. In reality, this equipment represents a revolution in military capabilities, a leading use of which is JPI.

The revolutionary capabilities that make JPI possible are exploitations of information and signal processing leading to:

- Continuous and NRT wide-area situation awareness;
- NRT target locating and tracking;
- Data fusion and processing to support rapid planning and replanning;
- Responsive, effective target engagement; and,
- Battle damage assessment (BDA).

By enabling light forces to "out see," "out plan," and "out shoot" an enemy force, JPI-capable equipment makes them viable in contingency operations. Great economies can be achieved, not only in the reduced quantities and sizes of equipment deployed, but in the

support such equipment demands. If one smart weapon replaces tens or hundreds of "dumb" ones, fewer weapons are deployed, fewer platforms are needed, fewer missions are flown, and fewer supporting missions are required. The greatest burden in Desert Storm was logistical, and this burden can be substantially reduced.

Many of the characteristics of JPI-capable equipment are also valuable in finding and attacking tactical ballistic missile launchers and support facilities. Wide-area situation awareness and responsive attack has the potential of making a significant contribution to attack operations.

1.8 JPI REQUIREMENTS

Successful execution of JPI will require:

- An optimization of the end-to-end "system of systems" architecture for effective systems integration and component development/acquisition.
- Continuous situation awareness, requiring NRT, WAS and target acquisition, <u>and</u> easily understood display, enabling instant awareness.
- The ability to pass situation and target information to all appropriate users without delay. (This ability must include the distribution of data to fire support units.)
- A joint or potentially combined command and control (C^2) structure, resulting in unimpaired decision making based on timely information.
- Responsive attack execution, including mission planning and appropriate weapon availability.
- Equipping expeditionary forces with adequate numbers of precision guided munitions (PGMs) to support intensive operations at high engagement rates.
- Training and exercising with sufficient frequency to ensure that commanders and staffs are fully acquainted with JPI capabilities and the joint/combined procedures necessary for its successful application.

2.0 RECONNAISSANCE, SURVEILLANCE, AND TARGET ACQUISITION (RSTA) FOR JOINT PRECISION INTERDICTION

2.1 RSTA REQUIREMENTS

The requirements listed below are based on the experiences of Desert Shield/Desert Storm and the spectrum of anticipated future conflicts, JPI missions, and target sets.

- Wide-area, simultaneous surveillance coverage over the entire conflict theater for situation assessment and target array detection.
- Focused surveillance over the battle area for target recognition, location, and selection.
- Continuous, all-weather and day/night capability with terrain and foliage masking penetration through appropriate sensor type allocation.
- Sensor resolution sufficient to conduct accurate and timely post-strike damage assessment.
- Near-real time, RSTA product cycle that accommodates short dwell/moving targets and sensor-to-shooter targeting.
- Common, accurate map, imagery and position database by fusing RSTA imagery, Defense Mapping Agency (DMA) and Global Positioning System (GPS) references, incorporating earth resource satellite capabilities, such as LANDSAT and SPOT.
- Integration of national, theater, and tactical sensor assets with JFC access control and access to a central, automated database.
- Enhanced national technical means capability with JFC access control, greater geolocation accuracy, and short timelines with possible surge capability.
- Sufficient counter-counter measures to maintain RSTA survivability and operational integrity against a sophisticated threat.

The necessity for wide-area, simultaneous surveillance coverage is the result of new battlefield dynamics and dimensions in which a broad range of target sets must be addressed throughout the conflict. Close and deep aspects of the air-ground battle are merging, interdiction is deeper (>500 Km) with a faster tempo, and the nonlinear battle area is widely dispersed and fluid.

As a result of these dynamics, NRT and all-weather battle area coverage is essential. High-resolution SAR imagery and MTI are preferred for target detection and recognition, with electro-optical/infrared (EO/IR) for fair weather back-up coverage and precision mapping. There is also a need for technology to better utilize medium-resolution (1-3 m) radar imagery to alleviate the resource bottlenecks imposed by demands for high-resolution coverage over wide areas with frequent revisits for mobile targets. Film-based sensors have timeline problems during the engagement phase. Moving to an all digital electronic format for RSTA intelligence collection, however, minimizes JPI mission turn-around time and maximizes the options for sensor fusion, data processing, and mission planning.

Fully exploiting certain precision guided munition capabilities requires very accurate geolocation reference. This requirement can be met by fusing the appropriate JPI RSTA imagery with GPS references. Products from national technical means (NTM) and earth resource satellite (LANDSAT and SPOT) can be useful here.

A common RSTA data base for mission planning can be developed by merging airborne and space products with near-perfect geolocation registry, using GPS clock and platform references. This imagery can overlay DMA products and provide the JFC with a

centralized, continually updated database of the theater target field. Furthermore, transmission and processing efficiencies would be realized if the sensor platform, equipped with on-board processing, distributed only image change information.

To maximize PGM efficiencies, BDA must be accurate and timely; high fidelity is often required. Since damage assessment is a high risk, focused task, unmanned aerial vehicles (UAVs) may be most appropriate for this mission.

2.2 RSTA CAPABILITIES

The JPI RSTA System Element consists of a family of space-, air-, and surface-based platforms with sensor payloads performing collection functions throughout the useful electromagnetic spectrum. Because position and time references are important to the RSTA function, GPS is also included, although it is not a standard sensor component directly performing target intelligence collection.

Since the primary RSTA function is to survey the theater area of interest and detect, identify, and locate primarily mobile enemy targets to support a precision interdiction mission, the favored collection modes are imagery intelligence (IMINT) and MTI. SIGINT and measurement and signature intelligence (MASINT) collection is critically useful if targets are available. Since the enemy can control emissions and limit detection, SIGINT and MASINT typically play supporting, yet essential roles in providing target position and identification data. In any case, the synergism of all these collector types and their sensing regimes enable precision targeting and full exploitation of today's PGM capabilities. Hence, utilizing the proper RSTA system architecture for the involved theater/target set is fundamental to the JPI mission's success.

Another RSTA feature essential for JPI mission success is the rapidity with which intelligence collection and processing is accomplished. With today's dynamic, nonlinear battlefield and highly mobile, deceptive targets, the ability to perform RSTA functions in NRT is critical. For that reason, charts in the classified annex, Appendix C highlight this aspect of each RSTA system as a key capability. With sensor-to-shooter automation, this NRT feature is even more critical.

This chart summarizes the RSTA intelligence collection capability associated with each of the primary RSTA systems. By definition, the data link gateways, communication relays, data processors, and intelligence processing terminals and centers are considered to be components of the C^3 System Element and are discussed in Section 3.0. The connectivity and proficiencies of C^3 components are, of course, also key to the success of the JPI RSTA function.

	IMINT	SIGINT	MASINT	OTHER
Spaceborne				
LANDSAT	EO/IR		EO/IR	
EOS	EO/IR		EO/IR	
SPOT	EO/IR		EO/IR	
DSP/FEWS[1]			IR	
NTM	X	X	X	
GPS				NAVIG/TIME REF
Airborne				
JSTARS	MTI/SAR	X		MTI
U-2R/TR-1	Photo/ASARS II	X		
RF-4C	Photo/SAR			
F-16R	ATARS			
AWACS		X		
Rivet Joint		X		
Quicklook II		X		
Guardrail V		X		
Imp. Guardrail		X		
GRCS		X		
Adv. Quickfix		X		
SR-UAV	EO/IR	(X)	(X)	(MTI)
MR-UAV	ATARS			
Pioneer	EO			
Ground-Based				
Teampack/PRD		HF/VHF/UHF		
Trailblazer		HF/VHF/UHF		
Teammate		HF/VHF/UHF		
Trackwolf		HF		
Embed Fence		X	X	ACOUSTIC/SEISMIC

2.3 RSTA ASSESSMENT

Key JPI RSTA problems, including those realized during Desert Storm, are listed below. Including findings from Desert Shield/Storm is relevant since the conflict was a living laboratory for evaluating the adequacy with which current military systems and procedures are able to perform JPI. The complete spectrum of sensors and precision weapons in a highly dynamic and nonlinear battle arena was applied to the JPI mission.

- Need a well-defined, overall system architecture and interoperability.
- Inadequate wide area, simultaneous surveillance coverage.
- Must address critical mobile target detection and identification.
- Enhance target geolocation accuracy.
- Timely sensor data fusion and exploitation.
- Incorporate NTM asset allocation with enhanced sensor capability.
- Enable selected sensor-to-shooter capability.

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[1] The Follow-On Early Warning System (FEWS) Program has been cancelled.

- Accurate and timely damage assessment is essential.
- Continue to strive for all-weather capability.
- Add technology to penetrate foliage and terrain masking.
- Counter-stealth and counter-deception capabilities.

It is essential for these RSTA problems to be addressed since future conflicts may be more demanding. With Desert Shield/Storm there was build-up time, air superiority, minimal electronic countermeasures (ECM), a good detection environment, and a demoralized adversary. A significant but fragile technological edge was enjoyed.

Without a preconceived JPI system architecture, it was necessary in Desert Shield/Storm to jury-rig a system for RSTA connectivity, sensor fusion, and intelligence processing, exploitation, and dissemination. Fortunately, time was available to form an ad hoc joint intelligence collection and processing concept and implement it.

JSTARS and TR-1/Advanced Synthetic Aperture Radar System (ASARS), supported by NTM, provided wide area coverage but, the inability to cover all areas continuously and simultaneously handicapped deep, mobile target acquisition. NTM assets are key. UAVs are potentially very valuable in these roles, but they are currently lacking in sufficient capability and quantity. Air breathers are limited by data link tethers. The utility of many airborne RSTA assets is limited by the requirement to remain within data link range of semi-fixed ground facilities. In some cases (e.g., JSTARS) the technical capability exists to release from the ground station tether by using SATCOM. In other cases, usually UAVs, an airborne relay may be advantageous.

A scheme to provide users with imagery in NRT is needed. A common database, mobile target processing centers, and targeting data that is sent directly to the shooter should lead to more timely utilization of sensor data.

Although most NTM supported the theater during Desert Shield/Desert Storm, tasking and distribution caused some delays and should become more transparent. In addition, initially there was inadequate MC&G support due to the unexpected conflict location. Surge concepts for responding to unforeseen needs may be cost effective.

Accurate BDA is far more important than previously thought, given the proficiency of precision weapons. Logistics are greatly reduced with confirmed kills, but effective BDA often requires high fidelity sensing, perhaps requiring close range observation with attendant survivability issues. UAVs may be the best risk trade-off.

All-weather capability is a continuing deficiency, despite the introduction of SAR through the ASARS and the MTI feature of JSTARS. Continuing advancements in SAR (e.g., polarometric) are necessary, as are the supporting capabilities of imaging infrared (IIR.) More platforms should incorporate SAR through hardware implementation enhancements. Weather will always be an impediment, but sensor advancements, sensor fusion, and digital processing can minimize the weather-associated problems.

The inability to observe the target, caused by foliage or terrain masking, is a serious deficiency that can be at least partially addressed through multi-spectral sensor technology. Combinations of microwave, millimeter, and infrared wavelength detection can collectively penetrate some levels of cover; hence, sensor fusion and correlation are in order. Of course, implementation will require advancements in miniaturization and cost reduction to fit the required variety and number of JPI observation platforms.

Some of the above techniques are applicable to the counter-deception and stealth issues. Sensor fusion and correlation are key here. Proper use of common database

IMINT, SIGINT, and MASINT can resolve some deception schemes. Advancements in stealth technology make this deficiency a growing concern in future conflicts.

3.0 C^3 FOR JOINT PRECISION INTERDICTION

3.1 C^3 REQUIREMENTS

JPI requires respor.ive, synchronized joint (probably joint and coalition) deep operations. The time elements of responsiveness and synchronization are stressing. The jointness, and probable multinational jointness, inherent in JPI is likewise stressing. The C^3systems and processes must be designed to manage these stresses if JPI is to achieve its potential. Organizational barriers to joint operations cannot be allowed to inhibit the process.

JPI C^3 requires a global network tailored for contingency operations. The unpredictability of future contingency theaters of operation requires U.S. forces to be equipped with C^3 systems that permit effective area C^3, as well as responsive and timely battle area C^3. This can only be done by adopting and fielding C^3 systems that utilize flexible or open system architectures containing appropriate sensor-to-shooter links.

Extended range, beyond line-of-sight communications will be essential for effective command and combat operations (air, surface, and sea).

Interoperable, automated communications network management and control are required to ensure effective C^2 network operations and to prevent mutual interference. There are such a wide variety and number of communications and combat systems on the battlefield, and such a limited frequency spectrum available, that their management and control functions must be automated.

Identification Friend, Foe, or Neutral (IFFN) continues to be a driving requirement, especially in combined force coalition operations. IFFN for air, surface, and seaborne forces requires a mix of cooperative and noncooperative systems. A prior DSB study[2] on lessons learned during Desert Shield/Desert Storm showed that there is no one solution for the identification problem and for preventing fratricide. Discriminating combatants from non-combatants or neutrals is even more difficult, but must be considered in the overall identification problem.

Secure counter-countermeasure (CCM) capabilities for U.S. and coalition C^3 equipment is essential, but these capabilities should be designed to be responsive to the threat at hand, not necessarily designed for the worse case threat. A mix of anti-jam and non-anti-jam equipment may be more affordable and more interoperable in coalition force contingency operations.

The GPS was extremely effective for U.S. forces during the Persian Gulf War. Future military operations in nearly every possible theater will require this same coverage.

3.2 C^3 CAPABILITIES

Desert Storm provided a testbed for current JPI C^3capabilities. We discovered that we have an abundance of communications capability and operations center equipment to support command and control. It is often not interoperable. There is no C^2 "system set" available for a theater commander nor are there procedures for establishing one. Instead, the theater must build a C^3system from the many diverse and independently developed components that appear in theater in response to a crisis.

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[2] Lessons Learned During Desert Shield/Desert Storm, Defense Science Board Study, May 1992.

Current global communications capabilities that are being applied to meet C^3 needs include both dedicated military satellites and leased circuits from commercial satellites. The military systems have limited wide band capabilities, but planning is underway to correct this limitation by leasing more commercial satellite circuits. The current placement of both military and commercial satellites is geared to the more industrialized parts of the world, but this situation will continue to improve as satellite broadcasts spread everywhere.

At the present time, extended range communications in the battle area depend on limited high frequency (HF) radios and UAVs equipped with radio relays.

Communications network management and control is done manually, but each of the Services is moving ahead on automated systems.

GPS receivers are being provided to all U.S. forces and are being integrated in various weapons systems. Other NATO countries are also producing and equipping their forces and systems with GPS capabilities. GPS is limited in other allied/friendly nations, but worldwide availability of GPS receivers should ultimately alleviate this problem.

3.3 C^3 ASSESSMENT

The C^3 capability demonstrated in Desert Storm was not sufficiently responsive for JPI. In particular, the Air Tasking Order (ATO) development and distribution system, requiring from 48 to 72 hours to respond to attack requirements, is inappropriate for conducting JPI.

There is no overall C^3 system architecture. CENTCOM, in Desert Shield/Storm, did a superb job of adapting its C^3 contingency plans to the theater situation, with the necessary inclusion of the multinational coalition forces' C^3 needs. The allied C^3 network, however, was basically an ad hoc arrangement that was quite fragile and vulnerable. C^3 operation centers are largely Service-oriented, with little consideration given to CINC needs, especially CINCs who must deploy to the theater of operations.

Because of the many different stand alone multi-national force C^3 systems, including those of the U.S. Services, the overall combat area C^3 architecture is not readily adaptable or flexible to meet the wide variety of command and combat needs. Most systems are incompatible. While there were problem areas in C^3 and intelligence collection and distribution, the ingenuity of the U.S. and coalition personnel resulted in effective "work arounds" to meet command and combat requirements. A good example was the ad hoc linking of Defense Support Program (DSP) Scud launch alert with Constant Source broadcast through satellite links to the in-theater C^3 network and strike systems.

Airborne C^3 systems, such as the Airborne Warning and Control System (AWACS), JSTARS, and the Airborne Battlefield Command and Control Center (ABCCC), were well integrated and provided a meaningful picture of the air situation for land and seabased management of combat operations. Linking these systems to GSMs, when an adequate number of modules become available, should increase overall force effectiveness and efficient force C^2.

The value and use of satellite communications to support contingency combat operations were dramatically demonstrated in Desert Shield/Storm. Satellites were repositioned to support allied operations, and an extensive network of satellite communications terminals was installed to meet coalition force C^2 operations. Commercial satellite circuits were used extensively. In a low countermeasures threat environment, these systems perform very satisfactorily.

Extended range or beyond line-of-sight communications are a major problem area. Even in the desert terrain of Saudi Arabia, the distances involved required more over-the-horizon type communications capabilities to ensure connectivity with all forces. BDA, especially for precision deep strike operations, was lacking both in terms of quality and timeliness. It was difficult to determine the level of damage inflicted to permit effective and rapid retargeting.

CCM capabilities built into U.S. military equipment have been designed to defeat the electronic warfare threat of a full scale NATO/Warsaw Pact conflict. This well developed capability may be more than is required for contingency operations.

GPS was a valuable C^2 asset in Desert Storm. For the first time in combat, U.S. and allied forces (to a lesser extent) had the capability to know where they were at all times, and the battle area, terrain, and sea were all referenced to a common GPS coordinated network.

IFFN remains a dismal situation. In Desert Storm, French Mirage aircraft were not flown for fear of misidentification as Iraqi Mirages. Identifying other friendly forces was mainly through C^3 means, which worked best if the enemy was not flying. The Mk-12 question and answer system is in U.S. forces and some other NATO forces. There are several unique noncooperative systems on different U.S. aircraft, but none on allied aircraft. There is no current air-to-surface identification system in widespread use; there is some limited capability air-to-surface identification equipment available, but no plans for widespread use. Surface-to-surface IFFN is largely by optical/visual means.

In general, the biggest C^3 problems derived from systems architecture issues - how things are organized rather than from specific technical problems. These problems were also recognized in the 1993 summer study reports on Tactical Air Warfare and Global Surveillance.[3]

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[3] To be released in January 1994.

4.0 MISSION PLANNING FOR JOINT PRECISION INTERDICTION

Typically, mission planning is not assessed on its own since there is not a well-defined view of what separates it from command and control. Mission planning is inextricably bound with command and control. Nevertheless, it is useful to examine mission planning in JPI since it is often the pacing function. The time consumed in mission planning can be of such duration that the mission is no longer valid in a JPI context. Therefore, JPI places unusually stressing requirements on the mission planning function, more stressing than in most other missions.

Mission planning is the process by which attack commands are translated into execution plans. It does not include target, platform or weapon selection. It begins when a command decision has been made to attack a target with a platform/weapon combination. Mission planning constitutes that combination of information processing and decision making which develops the mission data used in weapon delivery.

There are two levels of mission planning: force-level and platform-level. Force-level mission planning involves force packaging, deconfliction, and coordination. Platform-level mission planning is the preparation of detailed execution plans: routes, aimpoints, and procedures. Platform-level mission planning must conform to the deconfliction and coordination constraints of the force-level plan. Details of both levels are dependent on force structure, weapons, geography, and the enemy.

4.1 MISSION PLANNING REQUIREMENTS

The primary mission planning requirement in JPI, beyond the minimum ability to execute the ordered attacks, is responsiveness or timeliness. This means the ability to respond to unexpected and time-critical targets of various types. These targets may not constitute the majority of the total target set in a campaign but, at times during the campaign, might consume all available JPI assets. Mission planning systems and processes must be able to handle this surge of time critical targets in a responsive fashion.

4.2 MISSION PLANNING CAPABILITIES

Mission planning systems vary considerably according to the demands of the platform and weapon. Aircraft currently require the most intensive mission planning at the force-level due to the complexity of assembling their strike packages. Current air-launched weapons lack the stand-off and flexibility to allow this planning to take place in advance of target acquisition. Cruise missiles can require intensive mission planning depending on the form of guidance employed. The Tomahawk Land Attack Missile (TLAM), for example, requires considerable mission planning and data, which can take days to months to accomplish. Ballistic missiles, in contrast, require almost no mission planning time. This section will describe current and planned capabilities for the most demanding of these systems.

4.2.1 Air Force Systems

4.2.1.1 Current Capability

The Mission Support System (MSS) is the Air Force's unit-level planning system. This system was modified to MSS-2(DS) and used during Desert Storm, where it was fine-tuned by the users. This system is now undergoing modification by the Electronic Systems Division and will become the Air Force MSS (AFMSS).

4.2.1.2 Developmental Capability

The major Air Force program directed at developing force level planning is the Contingency Tactical Air Control System (TACS) Automated Planning System (CTAPS). It consists of four principal parts related to functional elements within the force operations center: Intelligence Correlation Module (formerly Tactical AF LOCE Capability); Rapid Application of Air Power; Advanced Planning System; and, Force-Level Execution. The development status and initial operational capability (IOC) date for each element of CTAPS is shown below.

Contingency TACS Automated Planning System (CTAPS)

	Development Status	IOC
Intelligence Correlation Module	6.4	1993
Rapid Allocation of Air Power	6.3A	1993
Advanced Planning System	6.3B	1992*
Force-Level Execution	6.3A	1997

* - USAFE, 1992; Korea, spring 1993.

Major functions of the four elements comprising CTAPS are:

Intelligence Correlation Module
- Current Situation.
- Threat Updates.

Rapid Application of Air Power
- Target Development.
- Target Nomination.
- Threat Data.

Advanced Planning System
- ATO Preparation.
- ATO Dissemination.

Force-Level Execution
- Execution Management.
- Defensive Planning.
- "Plan Repair."

CTAPS is being developed in an unusual way, and it is an excellent example of what the DSB has called a "fieldable brassboard." ACC is responsible and controls the funds, supported by Rome Laboratory and other development agencies. Thus, the user representatives are driving the system, describing it as an 80% solution initially. CTAPS will then be fielded to a variety of users (numbered air forces and commands) who will work with it as further capabilities are developed ("one bite at a time.") When the users are satisfied with the product, the intent is to return it to the acquisition community to produce an appropriately engineered but functionally identical copy.

The same organizations at ACC/Directorate of Requirements (DR) that are driving CTAPS are pursuing the broader view of Theater Battle Management with the following goals:

- Adopt open architecture software standards.
- Migrate toward common hardware.
- Provide common operating environment (operating systems, databases, languages, local area network standards, protocols, graphics programs, and man-machine interfaces.)

- Adopt common mapping/reference imagery system.
- Eliminate security as a constraint to automatic data exchange.
- Provide secure, integrated force-wide command, control, communications, and intelligence (C^3I) networks with no single point of failure.

To help the Air Force community accomplish these goals, the Air Force created a General Officers' Steering Group with members from a variety of Air Force user and developer commands, plus representation from MCS J-6, Navy N6, and the 3rd U.S. Army. This group is viewed by ACC/DR as an initiative to coordinate and integrate ongoing and planned development activities, identify and apply technology to today's problems, and accelerate the transition from lab to field.

4.2.2 Navy Systems

4.2.2.1 Current Capability

Navy planning systems are operated within Navy Tactical Command System Afloat (NTCSA.) The Joint Operational Tactical Systems (JOTS) is a positional display system based on data received via satellite communications, and is the primary C^3 element of NTCSA. NTCSA is implemented on all ships. Naval air planning is centered more on individual units that are anticipated to operate as autonomous forces (e.g., carrier battle groups), while Air Force planning tends to be more centralized.

4.2.2.2 Developmental Capability

Navy developmental systems include Advanced Power Projection & Execution System; Joint Services Imagery Processing System (JSIPS); Tomahawk Strike Coordination Module (TSCM); In-Cockpit Engagement Simulation System; and, Top Scene. The TSCM is comprised of the Advanced Strike Planning Tool (ASPT); Afloat Planning System for Tomahawk (APS); and, Tactical Aircraft Mission Planning System (TAMPS). Functionally, the Tomahawk Strike Coordination Module is similar to the Air Force CTAPS, and the Afloat Planning System/Tactical Aircraft Mission Planning System is similar to AFMSS. IOC dates for the various elements of the Navy Developmental Mission Planning System are shown below:

Navy Developmental Mission Planning System

	IOC
Advanced Power Projection & Execution System	1997
Joint Services Imagery Processing System	1995
Tomahawk Strike Coordination Module	≤1995
Advanced Strike Planning Tool	1996
Afloat Planning System for Tomahawk	1995
Tactical Aircraft Mission Planning System	opt 1 evolving
In-Cockpit Engagement Simulation System	
Top Scene	operational

The Afloat Planning System will be mounted in a van so it can be put ashore when the situation requires. TAMPS exists today and was used in the Gulf, but it was not updated adequately and proved to have many problems. TAMPS will be a pre-planned product improvement (P^3I) on APS. Top Scene is operational and was used extensively in the Gulf.

The Navy has, in principle, adopted the Copernicus architecture as the objective basis for its planning systems (among other applications). Copernicus is described as a

command, control, communications, computers, and intelligence sub-architecture and is not a specific program. It is an information flow management scheme using demand-driven ("user pull") approaches analogous to database query systems. It is comparable in function with the Air Force Theater Battle Management C^3 architecture; the two are competitive as the basis of any joint planning system.

The Organization of the Joint Chiefs of Staff (OJCS)/Directorate for C^4 (J-6) has determined that the Air Tasking Order (ATO) software of the Contingency Theater Automated Planning System (CTAPS) as the standard for ATO generation and dissemination, but how this is rendered effective is yet to be determined. The Navy is implementing parts of the Air Force CTAPS software in its own systems. An alternative under consideration is to create CTAPS implementation (e.g., van mounted) which could be placed where needed, including on a ship. However, there is no program to explicitly adopt the Air Force system nor to maintain configuration management between the Air Force and Navy systems. It is not clear that handover between Navy and Air Force JFACCs would be smooth. The keys are configuration control and joint exercises.

4.2.3 Marine Corps Systems

4.2.3.1 Current Capability

Mission planning systems used by the Marine Air-Ground Task Force (MAGTF) differ between amphibious operations and land combat operations because amphibious operations have a unique set of command relationships. Also, during the early phases of an amphibious operation, the MAGTF is embarked aboard ship.

When conducting amphibious operations, the command relationships between the Commander, Amphibious Task Force (CATF - a Navy officer) and the Commander, Landing Force (CLF - a Marine officer) change as the operation progresses from the movement to the amphibious objective area (AOA) through the ship-to-shore movement and finally to the seizure of the AOA. Until the CLF is able to assume command of the landing force ashore, the CATF commands the ATF. Accordingly, during all phases prior to the CLF assuming command ashore, mission planning in support of the amphibious operation is done with the Navy command and control systems aboard the amphibious command ship. The CLF's staff is collocated with the CATF's staff to ensure coordinated JPI planning. Once the CLF assumes command ashore he takes over responsibility for planning. Because most targets are beyond the range of supporting naval gunfire and field artillery, the CLF would likely task his aviation commander to oversee the planning and execution of the effort.

When the AOA has been seized and the amphibious operation is completed, the MAGTF may be given the mission of conducting sustained land combat operations, often in conjunction with the Army, as part of a larger Joint Task Force (JTF). In these circumstances, MAGTF mission planning would be conducted in accordance with the JTF commanders guidance and in conjunction with the JTF daily Air Tasking Cycle.

The Marine Corps does not possess long range quick-response surface-to-surface ballistic missiles such as ATACMS, nor is it expected to possess long range cruise missiles. Accordingly, targeting requirements not lending themselves to immediate attack by Marine aviation, will be passed to the Joint Force Air Component Commander (JFACC) for attack by Air Force or Navy aviation, to the Navy for attack by Tomahawk cruise missile, or to the Army for attack by ATACMS. Should the Navy develop and deploy a ship-based ATACMS-like missile, then the Navy also could conduct quick-response strikes against targets threatening Marine forces ashore.

The Marine Air Command and Control System (MACCS) is the overall system providing the Marine Air-Ground Task Force commander with automated support to exercise command and control (C^2) over MAGTF air operations. The Tactical Air Command Center (TACC) is the senior C^2 node for planning MAGTF air operations. MACCS equipment to support the TACC includes the Tactical Air Command Central (AN/TYQ-1) and supporting Tactical Data Communications Central (AN/TYQ-3A). These systems are jointly interoperable with Air Force, Navy, and Army aviation planning systems using TADIL-A and TADIL-B data links and U.S. Message Text Format (USMTF) messages.

4.2.3.2 Developmental Capability

The Advanced Tactical Air Command Central (ATACC) is the Marine Corps planning system currently under development. It is planned that this system will use a common operating environment with the Air Force CTAPS and Navy JOTS to facilitate portability. The Marines anticipate using the Air Force Common Mapping Standard (CMS).

The ATACC will have the flexibility to process USMTF, TADIL-A, and TADIL-B messages, and the capability of accessing Standard Query Language (SQL) databases. The ATACCS will be upgraded to process TADIL-J messages transmitted by the Joint Tactical Information Distribution System (JTIDS) currently under development.

Once data is received it is processed, correlated, and stored in shared databases for retrieval, manipulation, and use. The operator uses an intuitive easy-to-use interface. Real-time input from multiple sources, processed and correlated to remove ambiguities, provides nearly simultaneous changes in the situation displays.

Graphical information contained in the databases, including digitized maps, can be displayed on the operator's color monitor and sent to remote large screen displays set up in work areas outside the ATACCS modular shelter. Thus, groups of staff officers can analyze the status boards and displays without interfering with ATACCS operators in the shelter.

ATACCS has a flexible architecture with automated tools, powerful processing, and sophisticated communications that will allow for rapid modification and adaptation to meet rapidly changing requirements expected in future military operations.

To facilitate JPI planning, ATACCS will receive enemy situation and targeting data provided by national and joint intelligence systems. The Intelligence Analysis System (IAS) is the focal point for MAGTF all-source intelligence fusion processing. IAS has access to the DoD Intelligence Information System (DODIIS), the Navy Tactical Command System Afloat (NTCS-A), the Technical Control and Analysis Center (TCAC), the Tactical Electronic Reconnaissance Processing and Evaluation System (TERPES), and the Joint Service Imagery Processing System (JSIPS).

4.3 MISSION PLANNING ASSESSMENT

Desert Storm highlighted a number of deficiencies in the mission planning systems available to the Services and CINCs. During the five months of Desert Shield, many ad hoc systems and procedures were put into place and successfully used during the conflict. Many lessons were learned from the operation of these ad hoc approaches and the Services, particularly the Air Force and Navy, have initiated new developments for mission planning systems with emphasis on aircraft and long-range weapon planning. These efforts generally come together with IOCs in the mid 1990s.

There is a clear gap between JPI mission planning requirements and capabilities for air-delivered weapons. Hours are expended at both the force and platform levels in mission planning when, for many JPI targeting situations, response times in minutes are needed. With respect to aircraft mission planning, therefore, the current system lacks the necessary responsiveness.

This situation can be improved on the margin by better mission planning systems, both hardware and software, and improved communications, both format and bandwidth. However, revolutionary improvements in responsiveness, both at the force-level (e.g., ATO) and platform-level, can be achieved by adopting weapons which require little mission planning other than providing target location as input (e.g., Joint Stand-off Weapon [JSOW] and ATACMS.) Given a weapon with sufficient range and the capability to receive targeting data while the delivery platform is in-flight, aircraft mission planning could take place in advance of target acquisition. Target location input, rather than force packaging, would then become the critical timeline of air-launched weapon delivery, thus reducing response time from hours to minutes. Additionally, adopting wide area RSTA systems capable of determining target location without cueing (e.g., JSTARS) would provide an efficient means of obtaining the real-time targeting data necessary to prosecute such missions. For important and very fleeting targets, it may be necessary to update weapons in flight. An example might be SSM TELs, post-launch, when the situation dictates a long stand-off weapon with several minutes time-of-flight, with a target localization challenge that may take minutes to accomplish, and the weapon must arrive during a very small attack window, thus requiring the ability to update its desired impact location while enroute to the target.

5.0 WEAPONS/PLATFORMS FOR JOINT PRECISION INTERDICTION

Since JPI targets are not unique to the JPI mission, the weapons and platforms developed for other missions may potentially accomplish the JPI mission as well as those which originally inspired their development. However, JPI does impose requirements that are in some ways more stringent. Therefore, some additional capabilities are needed to adapt these systems to JPI, as described below.

5.1 WEAPONS/PLATFORMS REQUIREMENTS

The following sections address the JPI requirements for weapons and platforms independently.

5.1.1 Weapons Requirements

JPI demands that a commander be able to attack targets when and where such attacks will best support his operation. The commander will watch the enemy's operation unfold, select those targets on which an attack will contribute most to his scheme of maneuver, and order the attack, possibly in real time. Even at the operational level, this results in a requirement for highly responsive attack capabilities. The many competing missions for JPI assets imply a need for highly efficient target persecution. Platforms and weapons must possess qualities which make this possible. These qualities are:

- range great enough to permit interdiction throughout the enemy's formation;
- timeliness sufficient for responsive employment;
- accuracy to ensure selective target engagement and minimal collateral damage;
- lethality sufficient to ensure efficiency; and,
- deployability maximized for contingency operations.

Of the above qualities, those which are most peculiar to JPI are range, timeliness and lethality. In particular, the ability to hit and kill time sensitive targets at extended ranges is the distinguishing requirement of JPI.

Range. The air-delivered munitions suite was developed and procured for low-level attack. That strategy made sense when the principal air defense threat was represented by sophisticated Soviet missiles with acquisition radar which our delivery platforms would have to underfly. The Third World threat, best exemplified by Iraq, comprises both missiles and a large number of anti-aircraft guns, and forces the air delivery to high altitudes. This, in turn, greatly increases the requirement for precision guided munitions with sufficient standoff (50 - 150 km) from point defenses to ensure survival.

Timeliness. JPI targets fall into three categories: 1) High-time utility (not moving, but value of target is a function of time); 2) short dwell; and, 3) moving. For all of these, timeliness of the weapon is critical.

We cannot ignore the other factors listed above. In particular, systems which are difficult or costly to deploy to theater will have limited utility in the future.

5.1.2 Platforms Requirements

Platforms are distinguished from weapons in this discussion to highlight certain observations. A platform might be easily distinguished from a weapon, as in the case of a fighter/bomber dropping a bomb. It may not be so clear in other cases, such as a cruise

missile launched from a ship and carrying multiple warheads. It is useful to consider the requirements for both the ship and the cruise missile as platforms.

There are several activities performed by platforms in weapon delivery that were used in developing platform requirements. Platforms launch weapons toward targets. They must be positioned properly to perform this task, while surviving to fight another day. In some cases, platforms may have the added task of completing the target acquisition process, such as an aircraft in which the pilot visually identifies the target prior to weapon release, and a loitering platform which waits for the target to exhibit some type of behavior for weapon homing.

For JPI execution, penetrating platforms must have ranges approximating 400-500 km and total operating ranges may need to be much greater.

For fleeting or time-variant targets, platforms must reduce the time-to-weapon-release to a minimum.

For continuous availability, platforms must be able to perform their missions in all weather and as well as day/night with sufficient time on station.

For contingency operations, platforms must require minimal air/sealift and support. They must be able to provide the combat power necessary for a light insertion force to secure its base until reinforced.

5.2 WEAPONS/PLATFORMS CAPABILITIES

The capabilities of weapons and platforms are discussed separately, as were requirements in sections 5.1.1 and 5.1.2.

5.2.1 Weapons Capabilities

All targets can be attacked using currently available weapons systems. This was amply demonstrated in Desert Storm. However, the preponderance of the U.S. inventory lies in the area of short/no stand-off capability, and includes the CBU/GBU series of weapons, the Joint Direct Attack Munition (JDAM), TMD/SFW, BLU-109 and, Maverick and Hellfire missiles. After the long air campaign in which all but guns were nullified in the enemy's air defense capability, stand-off was not an issue. This is a luxury which cannot be assumed for potential future warfare. Even for short stand-off systems, efficiency demands a system such as JDAM. Also, except for ATACMS, current medium/long stand-off systems are most suitable for fixed targets. Future systems will improve that capability. Especially notable is the lack of current stand-off anti-armor systems. Despite a wide variety of current systems, adverse weather capability is limited. Meaningful improvements will be provided by TLAM Blk III for fixed targets, and by JSOW and ATACMS/BAT for mobile targets.

Range. (Specifics of weapons ranges will be found in more detail in the classified annex, Appendix Dπ.) The current inventory consists of weapons with ranges of from nearly zero (gravity bombs) to hundreds of kilometers (TLAM, ATACMS). The bulk of this inventory is in the shorter range category. Shorter range weapons (e.g., Mark 80 series and Mavericks) require the delivery platform to approach within local air defenses for effective delivery. Thus, shorter range weapons result in more vulnerability for the delivery platform. Laser guided bombs -- which are in short supply -- offer increased stand-off, but still require line-of-sight from the designating platform to the target. Only a few systems -- AGM-130, Have Nap, Stand-off Land Attack Missile (SLAM), TLAM and

ATACMS -- have the range to permit stand-off attack (i.e., outside of point and area defenses). There is, however, only a very limited supply of these longer range systems.

Timeliness. (Specifics of weapon responsiveness will be found in more detail in the classified annex, Appendix B.) This quality must be examined with consideration of both weapon and platform characteristics. All air-delivered munitions have, as a component of their responsiveness, the time-to-station of the aerial platform in addition to time-on-station. Normally, missions are carefully planned and coordinated, resulting in weapon delivery hours to days after the target is identified. When stressed, aircraft can be vectored to targets in minutes, but circumstances must be exactly right. The Air Force does not normally plan for such conditions. The same is true to a large extent with cruise missiles. The mission planning can take from hours to months. Ballistic missiles, in contrast, require little mission planning. Typically, a ballistic missile can be launched within a few minutes of target acquisition and will arrive over the target within 2-5 minutes of its launch.

Continuous availability. Again, this must be examined considering the weapon/platform combination. Most of the weapons and delivery platforms in the inventory require visual contact with the target, limiting availability to good weather. A few platforms, for example those with a LANTIRN (Low Altitude Navigation and Targeting Infrared for Night) targeting pod, have all-light and limited adverse weather capability. Some weapons can assist the platform by operating under weather, such as SLAM. Others are relatively impervious to weather, such as the ATACMS. Once again, the majority of the inventory comprises weapon/platform combinations which are adversely affected by weather.

Deployability. All inventory weapons pose significant deployability problems. Air delivered munitions demand airfields, aircraft, crews, support facilities, etc., much of which will probably have to be imported or constructed. Air delivery by long range bombers (B-1s, B-2s, and B-52s) largely overcome this requirement. Ship-launched weapons have fewer deployability problems, but ships have limited capacity for storage and handling of large weapons of that type. Ground launchers are not particularly easily deployed, but have considerable efficiency in operation and, once there, lend themselves to immediate availability.

5.2.2 Platforms Capabilities

Range. Fighter/bomber aircraft and cruise missiles have operational ranges of 1000 km or more. The current ballistic missile, ATACMS, has a range of over 100 km. Air delivery platforms include F-15, F-16, B-52 (USAF); F/A-18, A-6 (USN); AH-64 (USA); and, F/A-18, AV-8B (USMC). Other platforms include ships and the M270 launcher for ATACMS. Long range bombers can operate from CONUS or other out-of-theater bases, reach the theater in hours, and can potentially loiter for hours. Some, such as the B-2, are highly survivable. Other aircraft require: in-theater basing (or CVs), therefore requiring a few days to deploy; considerable mission planning, especially for survivability (except F-117); and, significant support. TACAIR, however, has long range and short time-to-target and is in good supply in the Air Force and the Navy.

Timeliness. Aircraft are normally employed in a manner that limits their timeliness to a matter of days. Cruise missiles require such detailed and resource-dependent mission planning that their timeliness, in the absence of extensive preparation, can be measured in days to months. Navy plans, if completed, will shorten this time to hours when supporting data is at hand. For fixed targets, the necessary extensive preparation could be done ahead of time, essentially reducing mission planning time to minutes and making missile flight time the driving variable. ATACMS platforms, M270 launchers, will be immediately

available and require only two to five minutes of preparation. Missile flight time is as short as two minutes. TLAM has no time-on-station and long mission planning times, but requires little support. ATACMS has a shorter time-to-target than TLAM and requires virtually no mission planning, but is shorter range.

Deployability. Aircraft, with the exception of long range bombers, require extensive and unique in-theater support facilities. The aircraft themselves can self-deploy, but much of their required support cannot. Aircraft entry into a theater is highly dependent on availability of facilities, adequate lift, and ability to receive and process airlift. Ships have a pre-existing support base afloat and can, in all cases where deep water is close enough to the theater, self-deploy. Surface platforms have indefinite time-on-station. Surface platform deployability, while not comparable to fly-in times of aircraft, can be improved.

Ground forces have a highly variable deployability, depending on the heaviness of the force. Properly equipped, configured and supported, a light ground force can be an effective executor of JPI. Such a force would be easily deployable. In contrast, deploying a heavy force, such as that deployed to Saudi Arabia for Desert Storm, requires considerable time and expense. The principal JPI platform for a ground force is the M270 launcher. The M270 vehicle is deployable; however, a battery with support equipment and three days of supplies requires over 50 airlift sorties.

The spectrum of JPI applications ranges from Libya (single air strike from out of theater) to Desert Storm (heavy ground, sea, and air forces). An intermediate level (e.g., Grenada, Panama) is more illustrative of JPI's potential. A light force, such as the 82nd Airborne Division (or a brigade slice) equipped with and supported by modern JPI equipment, could be highly effective without requiring a heavy reinforcing echelon.

5.3 WEAPONS/PLATFORMS ASSESSMENT

Range. The bulk of air-delivered munitions have insufficient range to provide adequate stand-off for survivability. This situation will require air defenses to be suppressed or eliminated, in turn requiring a larger force. ALCM provides, and JSOW promises to provide, adequate stand-off and setback for these types of engagements.

Sea-delivered weapons (TLAM) have adequate ranges.

Ground-delivered munitions, principally ATACMS, have insufficient range for the entire JPI mission. Extended Range ATACMS will provide adequate ranges.

Timeliness. Weapons and platforms requiring extensive mission planning (e.g., most air-to-ground weapons and some cruise missiles) are not sufficiently responsive for employment against moving targets or many moveable targets. Synchronized operations are difficult. These type of targets are best attacked by ATACMS and JSOW.

Accuracy and lethality. Many of the weapons in the existing stockpile predate precision guided weaponry. These weapons have limited utility in JPI. The smart and brilliant munitions technology, e.g., brilliant anti-tank (BAT), has now matured to the point where lethality is achieved efficiently through great terminal accuracy In light of the current "threat" and force downsizing, efficient weapons employing these technologies are especially cost effective.

Continuous availability. Many weapon/platform combinations are only useful in good weather. JPI requires continuous availability. Limited capability in this respect is

currently provided principally from ballistic missiles and a few aircraft equipped with LANTIRN.

Deployability. JPI weapons systems have great potential for providing high lethality to a light deployment force. At present, however, this potential has not been realized. Greater emphasis is required on maximizing the utility of long range firepower from light ground launchers and strategic air. For example, the M270 and its reloads require too much airlift for light force insertion. Strategic air, such as the B-52 or B-2, could deliver significant deep strike capability to any contingency theater if properly armed.

The current inventory is deficient in its ability to execute JPI adequately. Weapons in the acquisition pipeline correct many of the problems; however, budget constraints imply a very slow introduction rate for these new weapons. The revolution in weapons technology, if fully exploited and combined with the sensor revolution, would provide substantial efficiencies in other functional areas, such as C^3 and mission planning.

5.4 CONCERNS

At present, inadequate weapons are available or projected for potential JPI targets, and the time required to obtain operationally adequate numbers of weapons is long. (Specifics of acquisition strategies for JPI weapon systems will be found in more detail in the classified annex, Appendix B.) Many weapons that are not autonomous have data links that may be vulnerable, and may have inadequate stand-off. Other deficiencies include: lack of all-weather capability; limitations on stealth aircraft to night-only attacks; insufficient match between warhead lethality and kill requirements; inadequate ATACMS range, accuracy, and lethality for some target types; extensive requirements for TLAM route planning or programming; and, excessive weapons costs. There may be a need for a weapon that meets JPI range, accuracy, and lethality requirements, but there is no aggressive plan to develop such a system for various target sets.

6.0 RECOMMENDATIONS

6.1 JPI ARCHITECTURE

The four aspects of JPI -- RSTA, C^3, mission planning, and weapons -- are interrelated. Achieving maximum capability will require careful consideration of the many tradeoffs among these four aspects, as will obtaining an end-to-end capability at an affordable cost. For example, some deep strike assets require extensive target knowledge, large data throughput throughout the system, and considerable support for the attack. Other attack solutions do not require these capabilities. Some of these tradeoffs are:

- Smarter weapons as opposed to more accurate and/or detailed RSTA or mapping, charting, and geodesy.
- Longer stand-off weapons versus reduced platform vulnerability.
- Wider bandwidth communications versus reduced requirements through data compression technology, smarter weapons requiring less data (e.g., wire frame target description versus image), use of synthetic imagery, and transmitting only real information (i.e., data that is not redundant with existing databases.)

6.2 RECOMMENDATIONS -- RSTA

Important developments in RSTA are transforming the battlefield and making JPI possible. The greatest advance is in all-weather, stand-off WAS and target acquisition, with real time reporting.

The development of stand-off MTI radar with broad, NRT dissemination has caused a revolution in battlefield capabilities. It is most important, therefore, to maximize our WAS capability based on this demonstrated potential. Full exploitation demands sufficient coverage (24-hour, theater-wide coverage for two regional scenarios to support the base force) and real-time dissemination to tactical users at division level or below, up to and including component commanders.

MTI data, as exemplified by JSTARS, can provide displays which can be proliferated to users at lower echelons. This data can provide the basis for correlation with other sensor and intelligence data. Combining map data, MTI and SIGINT data can provide an easily interpreted display without major computing and processing requirements. In the long term, automatic processing of MTI radar is needed and possible, but substantial development will be required.

Effort should be focused on optimizing the trade-offs and relationships between WAS, focused surveillance systems, weapons' on-board guidance, and target acquisition systems. Proliferation of ground station modules is an efficient means of capitalizing on this revolutionary development.

SIGINT plays an important situation awareness, indication and warning, cueing other sensors, and determining order of battle role. Recent advances have given SIGINT a targeting potential unknown a few years ago. Communications High-Accuracy Airborne Location System (CHAALS), when fully fielded, will provide targeting quality location accuracy. (This capability is a significant advancement over previous SIGINT systems and should be exploited as fully as possible.) In areas hidden from stand-off sensors, unattended ground sensors and UAVs are also potentially high payoff.

In addition to WAS coverage, SAR imagery should be emphasized for its night and all-weather capability. The principal limitation on exploiting SAR imagery products today

is the lack of trained SAR imagery analysts and a lack of understanding in the intelligence and operations community about SAR products' utility and applicability. Emphasis is necessary in SAR training and education. Both SAR and WAS sensors should provide sufficiently high resolution to meet target recognition objectives and to augment damage assessment efforts.

National RSTA systems played an important role in Desert Storm with some limitations. Principal among these were the lack of wide area search capability and poor exploitation by and dissemination to the forces. Their contribution will increase with improved dissemination capabilities. Among the improvements needed is greater proliferation of Tactical Exploitation of National Capabilities (TENCAP) hardware, including Tactical Receive Equipment (TRE) and correlation/analysis systems such as the Enhanced Tactical User's Terminal (ETUT). The contribution of the total set of available space systems could be greatly increased through better use of proper combinations of both military and non-military assets (e.g., LANDSAT, SPOT). The technical issues in this are not demanding, rather, implementation is hindered by security considerations and funding.

Other recommendations include: establishing a multi-spectral signature database of critical mobile targets (CMTs) and their support infrastructure; and, applying multi-spectral sensing and other collection modes (human intelligence [HUMINT], IMINT, ELINT, and MASINT) to assist in recognizing and locating targets, as well as in countering deception and countermeasures. Other sensor systems, such as DSP/Follow-on Early Warning System (FEWS) and Brilliant Eyes could be refined for target cueing. High altitude, light weight, low cost surveillance UAVs with SAR/MTI payloads should be developed in support of CMT detection and identification. Maximizing the utility of these myriad sensors will require high-speed correlators to process products in NRT, compare data against the CMT database, and automate target recognition. This on-board sensor processing should shorten planning and, therefore, execution timelines. Lastly, advanced technology programs supporting CMT, such as the Advanced Research Projects Agency's War Breaker, should be emphasized.

Mapping, charting, and geodesy (MC&G) products are a critical lever of JPI system effectiveness. Data problems need to be addressed as soon as possible. Improvements in MC&G databases, however, must be prioritized with due consideration to trade-offs with other JPI components. For example, although different data sets continue to cause problems, use of relative guidance, relative GPS (providing target coordinates relative to the GPS coordinates of a reference grid), or other solutions could reduce or eliminate the resulting problems. Maintaining a complete, up-to-date, worldwide database is impractical given the enormity of that task. There will always be parts of the world with no coverage or poor, out-of-date coverage. Therefore, standard operating procedures for updating the database to respond to contingencies should be developed and exercised. Technologies to improve responsiveness are here or are maturing. DoD should recognize that improved MC&G would enhance JPI capabilities; however, improvements in other areas may enhance total system performance and mitigate the need for MC&G improvements.

Many other improvements are possible, but perhaps the greatest gains will come from improved processing and from user experience in combining the many capabilities available to him.

6.2.1 Technologies to be Pursued

In addition to automatic target recognition research and development, which has an all encompassing effect, there are a few high payoff technologies that will specifically improve RSTA. They are:

- Foliage Penetration (FOPEN) Radar.

- Affordable automated techniques to extract cueing and focused information from disparate WAS sources.

- Affordable Platforms for RSTA missions, particularly those which have long endurance and require a measure of survivability.

These three technologies, if pursued to successful conclusions, will provide robust and full regional RSTA and improve the adaptation of national means to theater and contingency operations.

While dissemination has been and may continue to be a thorny problem, its solution is technically assured with technolo. :s emerging from the commercial information systems revolution. A full solution awaits the settlement of cultural matters and establishment of priorities.

6.3 RECOMMENDATIONS -- C³ AND MISSION PLANNING

In the C³ area, technologies such as all digital formats and new data compression algorithms can improve data distribution. Improved computing hardware and software can improve correlation and, thereby, understanding. Greater efficiencies, however, can be gained by more fundamental changes. Broadcast RSTA information eliminates the bandwidth and time used in retransmission; weapons systems, which require much less data and mission planning time than current systems, are in development; autonomous stand-off weapons and proliferated MC&G products can greatly reduce pilot-generated imagery requirements, and allow much mission planning to be done before targets are identified. Of course, mission planning systems supporting current weapons must be improved.

A well planned, flexible, global C³ architecture is an important step toward achieving highly effective JPI capabilities. This architecture needs to be prepared by the JCS, in consultation with warfighting CINCs, and must incorporate open system attributes. The architecture must become mandatory guidance for both the Services and the acquisition community. The C³ architecture's design should fully examine the data, information, and dissemination needs of the users, i.e., the C² community and weapons systems. A thorough analysis of mission requirements must be undertaken -- with the understanding that there is a distinct difference between what users want, based on their past experiences, versus what data and information is mission-essential. The current C³ system is overburdened, with many users demanding more information than they need or can efficiently handle.

The new C³ architecture must meet the operational community's NRT targeting needs. To accomplish this task, the system should be designed to reduce dependency on hard copy products, especially hard copy imagery. Increasing digital data handling

capabilities could contribute greatly to reducing hard copy requirements; this capability should also improve the timeliness of data and information dissemination throughout combat theaters. In particular, image compression technology should be emphasized to reduce the amount of time the C^3 system dedicates to disseminating imagery products. An automated theater and tactical communications net control and management system should be developed on a fast track prototype basis for multi-Service use. This system should also be able to connect into the global C^3 network at various command levels.

Mission planning often drives the timelines for effective JPI mission execution. Streamlined mission planning is a critical element of improved C^3. DoD should emphasize systems that require minimal mission planning time and/or have embedded planning data. For those remaining systems requiring extensive mission planning, e.g., manned aircraft and cruise missiles, an automated prototype capable of rapidly updating and performing in-flight retargeting or rerouting should be developed in the near future for multi-Service use.

When reviewing mission planning needs and systems at the CINC/headquarters level, the best features of existing and planned Service programs should be combined to create a single, compatible, joint system, especially for aircraft mission planning. JCS, however, should not force joint system development at the unit-level. For Army systems, ATACMS should be included in a joint force-level planning system to the extent necessary to ensure their availability for JPI and to support airspace deconfliction. Commercial off-the-shelf displays/terminals should be used whenever possible to minimize cost.

BDA needs to be based on target activity, and must be accomplished as quickly and accurately as possible. BDA may benefit significantly from image compression technology, although a better understanding of the target and the intended attack effects may, in many cases, eliminate the need for imagery. Some degree of post-attack assessment should be included in all JPI delivery and weapons systems.

Another capability of the C^3 system should be improved extended range communications. This can be accomplished through a variety of means, including improving HF in all Services, using UAVs as communication relays; and, planning and approving commercial satellite leasing prior to the outbreak of hostilities.

DoD should accelerate deployment of GPS receivers. GPS should be installed on weapons delivery platforms and weapons themselves whenever feasible and affordable.

Related C^2 improvements should include restarting and accelerating the Mk-15 follow-on IFFN program. This program's development should be coordinated with NATO to ensure that all IFFN systems will be interoperable. All U.S. and friendly forces should be IFFN-equipped to prevent fratricide; the Air Force and Army should examine the potential for JSTARS and AWACS to assist in friendly/neutral force IFFN.

In light of the changing threat, JCS and the Services should examine requirements for CCM protection in C^3 and related electronics systems. These requirements must be tailored to the threat, appropriate for the range of possible contingency operations, and affordable. It may be possible to reduce substantially this type of equipment cost, or at least develop a more affordable mix of equipment with high CCM and low CCM equipment.

6.3.1 Technologies to be Pursued

The previously mentioned ATR initiative will markedly benefit C^3 and mission planning. To assure continuing innovation in C^3 mission planning, a robust and fast paced

program in advanced distributed simulation (ADS) is needed for both concept exploration and enabling. To assure the ability to have timely information available for C^3 and particularly battle management, the technologies required for affordable data links should be pursued aggressively.

ADS adoption is at least moving, but its pace and scope are much less than required. The technologies which will allow greater DoD use should be given greater emphasis and priority. These include establishment and adoption of protocols and standards, substantial improvements in the expansion of automated force capabilities, and the ability to synchronize and integrate the several forms of ADS (live, constructive and virtual.) While the challenge of implementing a pervasive and reliable backbone is not a technical matter, such capabilities are a *sine qua sim* for beneficial and confident use of ADS by operators and developers. A simulation communications backbone should have high priority for current implementation and future expansion.

The advancement of the use of data links (broadcast and individual) awaits cost breakthroughs ion two areas: the cost of the link itself; and, the cost of its integration with the appropriate platform - aircraft, missile, ship, land combat vehicle and C^2 node. The latter is often more costly than the former. This combined problem should be a priority subject of R&D activity as well as acquisition reform.

6.4 RECOMMENDATIONS -- WEAPONS/PLATFORMS

A revolution in stand-off attack capability, from air-, land- or sea-launch, has occurred. Full exploitation of this revolution will make a substantial contribution to a JPI capability. Given the variety of ground target types and potential delivery platforms, a mix of weapons (many of which can use the revolutionary improvements) should be developed and deployed.

Delivery platforms, including aircraft, missiles, and launchers, can become substantially more survivable through use of extended range munitions. Manned aircraft attrition can be reduced without loss of effectiveness through the use of weapons that permit the aircraft to operate outside the range of air defenses. Surface launchers become more effective with extended range munitions by allowing them both to cover more of the battlefield and to benefit from increased setback and dispersion. The availability of GPS provides an inexpensive opportunity to guide long range munitions to targets, which will increase launch platform survivability without proportional increase in cost or decrease in effectiveness. Most current weapons systems do not provide the desired stand-off, even though the technology is available and proven.

Weapons with an inherent ability to provide rapid attack are important for JPI execution because JPI focuses on attacking targets at the time that is most beneficial to the friendly operation's success. Because some JPI targets are fleeting, a capability must be acquired that will prosecute limited numbers of targets in very short timelines. The ability to select and attack those targets at the time and place of greatest military significance is a component of the "precision" in JPI. Obtaining this capability will require procuring longer range, semi-ballistic, air-to-surface and/or surface-to-surface weapon delivery systems not currently in the inventory.

Weapons accuracy can now be embedded in platforms and munitions, thus reducing the requirement for soldiers or aviators to risk close proximity to heavily defended targets to obtain lethal circular error probables (CEPs.) This same accuracy makes it possible to attack targets with less likelihood of collateral damage or unnecessary casualties. Technologies are now available whereby this accuracy can be obtained without the staggering costs previously associated with such a capability.

Munitions technologies are advancing rapidly. Millimeter (Wave) Integrated Circuit and Very High Speed Integrated Circuits (VHSIC) have enabled weaponized multi-mode sensors. This avenue has tremendous potential for highly efficient target kill, especially in a camouflage, cover, and deception environment. Acoustic sensors, as one of the modes, have great promise for large footprint applications. In areas hidden from stand-off sensors, smart wide area mines are also potentially high payoff. These technologies should be vigorously pursued. Given the advances in munitions, adoption of warheads for proven missile platforms is now appropriate.

6.4.1 Technologies to be Pursued

Effective ATR when fielded will revolutionize the efficiency and effectiveness of attack planning, execution, and BDA. With very few exceptions, the required weight and volume of delivered explosives is the result of inadequate target detection, classification, accurate and transferable localization exploitation of target vulnerability and rapid and reliable damage assessment.

Fully realized ATR capabilities improve every function, particularly when it is coupled with flexibility in mission planning and battle management. Order of magnitude improvements in per sortie and missile delivery can be realized with the fielding of successful ATR.

Beyond ATR improvements, research and development should emphasize:

- New lethal mechanisms for attack of all target types at higher levels of efficiency and with improvements in BDA signatures.

- Low cost techniques to retrofit existing busses (cruise and ballistic missiles, HARM, MLRS, rockets, etc.) with more efficient and lethal submunitions.

- The development of very low cost lethality measures to counter jamming threats to GPS.

Research, development and fielding of capabilities described above will improve the combat efficiency and effectiveness of our smaller future force and maintain their conventional combat dominance with powerful and discriminate means.

APPENDIX A

OPERATIONAL OVERVIEW OF JOINT PRECISION INTERDICTION/JOINT PRECISION STRIKE

Joint Precision Interdiction (JPI) is intended as an integral operation of a Commander-in-Chief's (CINC) and Joint Force Commander's (JFC) theater campaign. It has evolved from a convergence of changes in the world security environment, changes in warfighting operational concepts, a revolution in technological capabilities, and insights derived from associated war fighting analyses and Operation Desert Storm (ODS).This appendix summarizes these changes and the insights that provide the rationale and requirement for JPI operation (Sections A.1 - A.4); and, presents the Task Force's views regarding the objectives, description, and requirements of the JPI operation (Section A.5.) The latter is intended as context for subsequent chapters of this report.

Section A.1 - Changes in the World Security Environment

For nearly fifty years, the world political/military environment was dominated by the bipolar relationship between the Soviet-led Warsaw Pact and the NATO Alliance. During these years, the Pact maintained a significant conventional force advantage over NATO, causing NATO to rely on nuclear means to deter a massive Soviet offensive in Europe. To preclude further force imbalance, U.S. defense budgets increased significantly over the last decade to "modernize" the military departments following the lean Vietnam-era years. Concurrently, NATO developed the Follow-On Forces Attack (FOFA) concept in the mid-1980s to assist in raising the nuclear threshold. The U.S. and the Soviet Union maintained strong influence over policies and activities within their alliances. The Soviets simultaneously exercised significant control over many Third World military activities via economic means, technology controls. and subtle military pressure. Although regional conflicts occurred during this Cold War environment, each conflict coupled with pervasive concern regarding escalation, it was a relatively secure and stable global environment.

Although underlying causes and interactions are difficult to ascertain, events and activities that have occurred over the past three years have radically changed the European, global, and national security environment. Some of these are noted below:

- CFE talks. These talks, and the resultant treaty, were the first step in eliminating the major force imbalance that had existed in Europe for more than 40 years. The breakup of the Warsaw Pact, the collapse of Soviet communism, and the dissolution of the Soviet Union further reduced the massive threat to NATO and led to unilateral reductions by the non-U.S. NATO allies. *Threats to NATO and NATO forces are smaller!* NATO restructured its forces (making them more multinational, creating the Rapid Reaction Force) and, given this reduced force-to-space ratio, created new operational concepts for the nonlinear battlefield, e.g., "Counter Concentration."

- Cuts in U.S. defense budgets. As a result of these cuts, which reflect Congress' "peace dividend" of approximately 3-5% per year in real dollars for at least five years, DoD will suffer major force cuts to the Chairman's Base Force by 1995, and further reductions are likely. *U.S. forces are getting smaller and will be equipped with fewer systems!* U.S. strategy is changing to "forward presence" with more CONUS-based forces. U.S. operational concepts are being revised to

reflect a more proactive and offensive attitude, e.g., AirLand Battle-Future (ALB-F) became AirLand Battle Operations (ALO) and evolutionary changes continue.

- Changing global economic environment. The former Soviet Union is clearly in economic disarray and U.S. economic leadership has lessened. Japan has demonstrated its ability to strongly influence financial markets, and the German economy will likely grow to pre-World War II capability. Oil has increased the wealth in many Gulf nations, and industry has had the same effect in many East Asian nations.

- Wider availability of modern technology. As noted in a recent GAO report, modern technology is available to all nations. There are many buyers (Mideast nations, Libya, South Africa, India, Israel, and others) and many sellers (Russia, China, North Korea, Brazil, and the U.S.).

- Operation Desert Storm. This conflict verified the importance of modern technology, provided valuable insights regarding conflicts in the new global security environment (summarized in Section A.4), and stimulated changes in the U.S. defense strategy.

- New U.S. National Military Strategy (NMS). This new strategy focuses on regional conflicts and crisis response. It emphasizes forward defense without forward positioning -- with a concomitant drawdown of overseas forces and emphasis on power projection for contingency operations -- "come as you are" wars. It highlights joint requirements to support coalition partners. It codifies the new military success criteria: apply decisive force to win swiftly, with minimum casualties.

- New acquisition policy. A new DoD acquisition policy, which responded to the reduced defense budgets, was developed. Recognizing the importance of maintaining an overmatch with smaller forces, the new policy places strong emphasis on science and technology to maintain the current U.S. technology overmatch. It will result in fewer new system starts and less procurement.

These events and activities have produced a dramatically different global security environment: a new multi-polar world that is more disorderly, unstable, and uncertain -- resulting in increased likelihood of Third World conflicts. For example, Saddam Hussein continues to rule in Iraq; uncertain relations continue between Israel and Arab nations; civil war exists in Yugoslavia; Czechoslovakia will divide/ partition; border disputes and ethnic warfare occur across the former Soviet Union; and, there is widespread unrest in Peru, Panama, Thailand, Haiti, Afghanistan, and South Africa. This environment will undergo even further changes as a result of the anticipated revolution in military technology.

Section A.2 - Evolution of Warfighting Operational Concepts

An operational concept is the means of applying military forces by a senior commander to prosecute a war, and it is the mechanism for implementing a theater's campaign strategy. It is developed by a CINC for his specific theater, and by military planners in CONUS. These concepts have evolved due to changing operational needs in the new global security environment and in anticipation of new technologies. This evolution was focused on pre-CFE Europe, but it is now global in the new security environment. The need for JPI operations stems from these evolutionary changes in warfighting operational concepts. These concepts are summarized here.

Late 1960s-early 1970s. The "forward defense" strategy and operational concept replaced the "trip wire" as NATO's strategy. As a political imperative, NATO's main defensive forces were oriented toward territory. They were positioned somewhat "linearly" along the Inter-German Border (IGB), defending the main avenues of approach of a potential Soviet offensive. These forward deployed forces, and in particular their covering forces, performed the main surveillance and reconnaissance missions to determine the location of the enemy's main attack. To defeat this defensive concept, the Soviet-led Warsaw Pact planned to attack in particular sectors of the IGB with mass and velocity to "saturate" the retaliatory capability of NATO's main defense positions in those sectors, and then penetrate to the west. Because of the length of the IGB and the *a priori* positioning of forces along it, many of these forces could not engage the enemy's main attack. The "active defense" operation within the forward defense operational concept was designed to alleviate the saturation effect through the use of killing zones and rear/sideward mobility that would delay the enemy and extract maximum attrition on him in NATO territory.

Late 1970's-early 1980's. ALB doctrine replaced the active defense doctrine in the United States. Anticipating technology developments in the U.S.. it focused on destruction of enemy forces rather than on territory. NATO's forward defense operational concept began changing in the early to mid-1980's. Although the political imperatives of the forward defense operational concept still required an orientation on territory, FOFA operations replaced the active defense in NATO. It was still a strong forward positional defense, but the notion of trading ground for time and attrition was eliminated. FOFA was designed to alleviate the saturation effect in the linear battlefield, without trading ground for attrition. Capable assets, i.e., fixed wing aircraft, artillery, rotary wing aircraft, would attack uncommitted second echelon Soviet forces to destroy, delay, disrupt, and divert them in Warsaw Pact territory. The intent was to break the tempo of the massing follow-on forces, and to meter their arrival at the Forward Line of Own Troops (FLOT) so they could be effectively serviced by the main line of defense forces. In effect, FOFA "attacked deep to influence close."

Given the dramatic changes that have taken place in the global and national security environments, military planners in the U.S. and Europe have been designing new concepts for operating on a "nonlinear battlefield." This battlefield envisions smaller numbers of forces and more territory, with concomitantly reduced force-to-space ratios. It envisions a more mobile battlefield over extended distances with simultaneous deep and close operations over this extended battlefield. A number of similar and related concepts are continuing to evolve, i.e., Counter Concentration and Airland Operations, all of which focus on the enemy rather than on territory. Since these operational concepts are designed for a nonlinear battlefield, they are often referred to as "nonlinear operational" concepts.

Key changes are inherent in the new operational concepts. The theater CINC/JFC is the implementer, not the corps commander. Combat resources, which are now reduced in number, are retained at the "corporate" level for centralized commitment where and when needed on the battlefield, not distributed *a priori.* High technology sensors replace FLOT units as the principal surveillance and reconnaissance means, and they acquire the enemy with precision for leveraged attack. All firepower is employed effectively via the centralized control of forces -- in contrast to the earlier forward positional defense concept in which many of the land forces were ill-positioned to engage the enemy's main attack. The concept focuses on concentrating fires, not just forces. The centralization places a premium on mobility to focus the forces on the enemy. Deep attack (Air Force air interdiction, Army "Deep Fires," and Navy off-shore attack operations) is used to

attack enemy centers of gravity. Contrary to FOFA, the new operational concepts envision "attacking deep to influence deep."

The new operational concepts are proactive and offensively oriented. Deep attack fires are focused on the enemy in his territory to seize the initiative early in the campaign. Deep strikes are intended to force the enemy to go where the CINCs/JFCs want them to go, and to prevent him from maneuvering forces, i.e., "shape the battlefield." Deep attack activities are also intended to attrit and weaken enemy forces before committing maneuver forces to inflict decisive defeat and take control of territory. The concept envisions continuous activities of detecting the enemy, preparing for battle, establishing conditions for decisive maneuver engagement (attrit deep, attack enemy mobility, protect the force, position maneuver units), decisively winning the close combat engagements, and reconstituting.

The concept envisions simultaneous conduct of deep and close operations. In a contingency conflict with entry required during an enemy's attack operations, the new operational concept may require simultaneous performance of air superiority operations, fixed wing air interdiction operations, Army deep "attack operations," and Naval off-shore deep strikes to ensure decisive victory.

As suggested above, deep attack operations are an integral and critical component of the new operational concepts on a nonlinear battlefield. In the CINC/JFC operational concept, JPI is a subordinate operation within the overall deep attack operation.

Section A.3 - Revolution in Technological Capabilities

These evolving operational concepts have given rise to the need for a JPI capability. Consistent with historical interactions, these new operational concepts have also evolved because of the emergence of new technologies that provide the fundamental capabilities needed to implement the concepts, including the JPI operation. These technologies and their associated capabilities are discussed in subsequent chapters of this report. At this juncture, we note some of the relevant technologies that are beginning to emerge:

- Sensor systems for broad area surveillance/reconnaissance (intelligence) and precision targeting under all environmental conditions (day/night, all weather);
- Security/countermeasure systems ;
- Data processing and communications;
- Delivery systems;
- Precision munitions; and,
- Position/location devices.

These technologies will facilitate full and rapid U.S. implementation of the new operational concepts worldwide, including their component operations of deep attack, JPI, and maneuver overmatch.

Section A.4 - Insights from Warfighting Analyses and Operation Desert Storm

Many of the initial military ideas for the new operational concepts were developed, evaluated, and enhanced in simulation-based warfighting analyses begun in 1987 by SHAPE, EUCOM, and TRADOC. While these earlier analyses concentrated only on European conflicts, there are now continuing analyses of these concepts in conflict situations worldwide. The primary purpose is to understand their underlying warfighting dynamics when the force sizes involved are significantly reduced. Operation

Desert Storm verified the efficacy of many of the ideas and notions underlying the new operational concept. This section lists insights developed from simulation-based analyses and from Operation Desert Storm. These insights affect the description and requirements for the JPI operation within the new operational concepts.

The insights listed below were derived from simulation-based warfighting analyses conducted by military planning agencies from 1987-1992. These analyses involved the use of joint and coalition forces in simulated regional conflicts worldwide from 1990 to 2005.

- During the Cold War era, feasible changes in various conventional warfighting components, i.e., force structures, modernization, deployment capability, and operational concepts, could not alter the conventional force imbalance in Europe. Instead, NATO relied on nuclear means to deter a massive Soviet offensive in Europe. With significantly smaller force sizes in the new global security environment, many of the war fighting components can affect the ability to win conventionally, with modernization being a very high leverage component.

- The smaller the U.S. forces are, the more modern they must be. Conversely, modernization has significantly increased leverage when forces are smaller.

- The U.S. must maintain a significant RSTA advantage to ensure successful implementation of the new operational concepts. The U.S. must "win the battlefield information war" by (1) seeing the battlefield (surveillance/reconnaissance) and *stopping the enemy from doing so*; (2) acquiring "high payoff" targets and *stopping the enemy from doing so*; and, (3) ensuring effective operation of precision munition sensors and *countering the enemy's efforts to do so.*

- Real time or near real time C^3 is needed to implement the nonlinear concept successfully. Rapid C^3 is needed for both precision interdiction and responsive mobility of maneuver units.

- Deep attack is a critical component of the new operational concepts and the ability to "win decisively." Precision interdiction against high payoff targets must be conducted responsively.

- An integral component of the new operational concept is the ability to "win the maneuver war" by creating a mobility differential between the U.S. and enemy forces -- and by ensuring success in the less frequent, but important, close combat battles. The latter is needed to achieve the U.S.'s territorial objectives and to conclude the war.

- Deployment capability is as important as employment capability. When the enemy's D-Day occurs, the U.S. and its coalition partners must be ready in theater with deep attack capability (even without the availability of ground maneuver unit offensive capability) in order to protect ports of entry, airfields, and enclaves for entering forces.

- As the lethality of advance systems increases and as they become available in the marketplace, the importance of protecting U.S. forces becomes paramount. This can be achieved in many ways, including winning the battlefield information war and using deep attack assets.

- The ability to "win decisively, swiftly, with minimum U.S. casualties" requires significantly enhanced warfighting capability. (The new NMS specifies having force exchange ratios [FER] of approximately 5.0 or greater, a sharp contrast to the FER levels of 1.5 - 1.7 deemed acceptable in Cold War warfighting analyses.) This level of warfighting capability can be achieved with appropriate modernization and full implementation of the new operational concepts.

Operation Desert Storm employed many of the notions inhe... in the new operational concepts. This conflict and its related analyses appear to veri... ...ay insights developed through simulation-based warfighting analyses. These are noted below:

- It highlighted the importance of: "winning the battlefield information war," using JPI to set conditions for decisive operations, protecting the force enclave and ports of entry, and providing a close combat overmatch to facilitate decisive defeat of the weakened threat.

- It highlighted the importance of a technological/modernization overmatch, as well as a training overmatch.

- It highlighted the synergism of employing multiple systems, i.e., fixed wing air, rotary wing air, ATACMS, and TLAM in a coordinated joint deep attack operation.

- It identified the need for improved C^3, particularly joint C^3 (e.g., in the frag ordering process and in air defense among the Patriot, AEGIS, and AWACS).

- Although there was no combat in Operation Desert Shield, subsequent analysis of its likely combat outcomes highlighted the importance of rapid deployment and employment of deep attack assets.

In addition to verifying the notions of earlier analyses, Operation Desert Storm created a new national criterion for success: the forces must win decisively, swiftly, with minimum casualties . This criteria has since been codified in the new NMS.

It is important to recognize that the conditions for implementing the new operational concepts in Operation Desert Storm were somewhat ideal and are unlikely to occur again. There are lessons that potential enemies will also learn from Operation Desert Storm, as noted below.

- Don't wait for the U.S. to build up. Initiate an attack as soon as possible, within days of U.S. deployment.

- High technology modernization is important in the new global environment with greatly reduced forces. It is available in the marketplace and should be procured.

- An air defense capability is critical to counter the extensive U.S. tactical air capability.

- Attack ports of entry, force enclaves near ports, and airfields early on, particularly with surface-to-surface missiles.

Section A.5 - Objectives, Description, and Requirements for JPI in a Multi-Corps Theater

Previous sections of this appendix described the need for and evolution of new operational concepts for employment of forces on the nonlinear battlefield. These sections also provided some analysis and OSD-based insights regarding capabilities needed to implement these concepts. These include:

- Smaller forces, with more territory to cover, make modernization a high leverage warfighting component.
- Reduced defense budgets mean fewer new systems and less procurement, necessitating "higher return on investment" when new systems are procured.
- The CINC/JFC, who will orchestrate new theater operational concepts that envision a more fluid battlefield with highly mobile forces that engage the enemy anywhere on the battlefield, will also recognize the associated requirement to "win the battlefield information war."
- The NMS emphasizes crisis response, more CONUS-based forces, more power projection, with a concomitant requirement to protect ports of entry, airfields, and force enclaves. Commitment of U.S. forces will occur only if they can win decisively, swiftly, with minimum casualties.

The purpose of this section of the appendix is to provide an overview of JPI operations, as perceived by the Task Force, by specifying its objective, describing what it is, and listing some of its requirements.

The objectives of JPI are to provide the JFC with the capability to attack <u>high payoff</u>, <u>deep targets</u>, to assist in prosecuting new operational concepts on the nonlinear battlefield, to assist in winning the information war, to create mobility differential with the enemy, and to attack the enemy's strategic and operational "centers of gravity."

"High payoff" targets are those enemy assets which can significantly disrupt the CINC's/JFC's successful prosecution of his operational concept, and whose destruction would significantly enhance prosecution of the operational concept. High payoff targets are those targets of direct importance to the JFC.

"Deep" targets are those that are usually (but not always) beyond a corps' Area of Responsibility (AOR). JPI is primarily an Echelon Above Corps operation, but can include targets within the corps' AOR.

"Time sensitive" targets, i.e., those that are moving, short dwell, or long dwell but with a short time until the mission is performed, must be serviced within hours and minutes. Although targets for JPI will vary by theater, the nature of these targets can be discerned by considering the following enemy assets in the context of Operation Desert Storm:

- Surface-to-surface missile (SSM) sites <u>in range</u> of the ports of entry at Ad Dammam, command posts at Dhahran, and U.S. forces enclaved at King Khalid Military City.
- Airfields and Forward Area Rearming and Refueling Points (FARRPs) <u>within range</u> of the enclave or the "left hook."

- Enemy command posts controlling high-value maneuver unit, air defense, and intelligence assets.

- Critical sensors scanning the area of the forthcoming "left hook."

- Maneuver units moving to interdict the "left hook."

- Chemical SSM sites and facilities.

- Critical electronic warfare (EW) capabilities degrading U.S. intelligence and C^3.

- Deep fires capability within range of the "left hook."

As JPI-type targets will vary by theater, they need not include this broad spectrum of targets. EUCOM's perspective and requirements for JPI are, in fact, more focused. JPI operations are focused on creating a mobility differential by striking primarily deep maneuvering units that could significantly affect the JFC's operational concept. It is an enhancement of FOFA in that its intent is to "attack deep to influence deep," to influence the enemy operationally, to influence the enemy's tempo, and to prepare the threat for decisive defeat by maneuver units.

Joint Precision Interdiction is an operation conceived and directed by the JFC to support execution of his operational concept. It is truly a "joint" operation in that it is used:

- For integrated planning at the operational concept level;

- For effective utilization of scarce resources (sensors, delivery platforms, precision munitions) since no single Service will have enough assets to perform JPI over all targets;

- To ensure [illegible]ss over the complete JPI "time sensitive" target set;

- To provide all weather, day/night JPI capability;

- To ensure capability early in the theater campaign for simultaneous JPI operations over the complete battlefield; and,

- To provide a robust JPI capability in the form of fixed wing air (stand-off and direct attack), rotary wing air, ground launched missiles, and sea launched missiles -- none of which the enemy cannot prepare for or counter.[1]

JPI is a "precision" operation. The precision aspect of JPI requires that it is synchronized in time and space to get the maximum effect in executing the JFC's operational concept. Additionally, the precision indicates that JPI must be accurate in attacking a specific target in a low target density environment, and in avoiding collateral damage.

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[1] This requirement is highlighted in *Joint Pub 1* (page 48) by a quote from Vice Admiral Arthur, "In modern warfare any single system is easy to overcome; combinations of systems, with each protecting weak points in others and exposing enemy weak points to be exploited by other systems, make for an effective fighting force".

JPI's usual intent is to destroy the target for strategic and operational effects, not delay or meter the enemy as in FOFA. JPI is not all deep attack operations! It is a subset of:

- Air Force interdiction operations,
- Army deep "attack operations", and
- Navy deep attack operations.

Each Service provides assets (sensors, delivery platforms, munitions) for JPI operations by the JFC, but each retains others for use in its Service-unique missions and operations (e.g., air interdiction of bridges, power plants; counterair missions; air superiority missions; attack operations by and in support of a corps, division, brigade.)

Implementation of the JPI operation in a theater involves continual performance of a number of related processes. These include: intelligence gathering (situation assessment), target determination (deciding what enemy assets should be JPI targets), acquisition of these targets, JPI mission planning, JPI mission execution (target destruction), and battlefield damage assessment.

Responsibilities and authorities for JPI flow from the JFC. He assigns AOR, priorities, and tasks component resources for JPI execution. The joint management structure for executing JPI is theater dependent and specified by the CINC/JFC. JPI planning and resource allocation (apportionment?) is centralized, but detailed mission planning and execution is decentralized for performance by the selected component.

At times, a JFC's JPI target might be within a corps AOR. Since other deep attack operations may be going on within the corps AOR (e.g., Army shaping the battlefield with support from the Air Force, Air Force performing air interdiction and SEAD with possible support from the Army), JPI operations within a corps AOR will require extensive coordination with the corps commander to preclude interference with these operations.

This overview description of JPI suggests a number of technological, organizational, and procedural requirements in the development of a JPI capability. These are noted below:

- JPI assets (sensors, tactical air wings, Army missile attack forces, ATBM, Navy deep attack assets, Special Operations Forces) must be capable of early mobilization and deployment. They may be required to be operational in theater earliest to protect the ports of entry, airfields, and enclaves for entering forces.

- Effective implementation of JPI may require simultaneous performance of air superiority operations, Army deep attack operations, Navy off-shore deep attack operations, and JPI operations early in a contingency conflict.

- JPI will require broad and rapid dissemination of surveillance and targeting information. All participating elements must have a common perception of the battlefield.

- JPI operations will require centralized C^2 and planning, but decentralized execution.

- JPI will require finely-tuned coordination and orchestration between and among JPI operations, air interdiction, Army attack operations, Navy deep attack operations, and SOF operations.

- The ability to attack a JFC's high-payoff, time-sensitive targets will require significant compression of time lines for JPI planning and execution.

- High-payoff, time-sensitive targets must be attacked when and where specified by the JFC. Accordingly, this requires JPI to have all weather, day/night capability.

- Following the new OSD Corporate Information Management (CIM) tenets, a common C^3I architecture should be designed for JPI. Each CINC/JFC will then determine how to tailor this architecture to his specific theater.

- JPI will require the development of generalized techniques, tactics, and procedures for its implementation. These will be tailored by each CINC/JFC to his specific theater (e.g., JSTARS apportionment and allocation to maximize support to the theater/corps, intelligence/targeting, etc.).

- Since JPI operations will be executed using component assets, realizing a JPI capability will require continued development, testing, and fielding of JPI systems (sensors, delivery platforms, precision munitions, etc.) via Service acquisition processes. However, these acquisitions must be coordinated and integrated by OSD/JCS to ensure availability of a responsive, effective, and robust JPI capability.

- The joint and surgical nature of JPI will require the development of appropriate training strategies and associated programs.

APPENDIX B

CHAIRMAN'S TASKING

(Appendix B is classified and is contained in a separate document.)

APPENDIX C

RSTA CAPABILITIES

(Appendix C is classified and is contained in a separate document.)

APPENDIX D

WEAPONS CAPABILITIES

(Appendix D is classified and is contained in a separate document.)

APPENDIX E

ABBREVIATIONS AND ACRONYMS

ABCCC	Airborne Battlefield Command and Control Center
ACC	Air Combat Command
AFMSS	Air Force Mission Support System
ALB	AirLand Battle
ALB-F	AirLand Battle-Future
ALO	AirLand Battle Operations
AOA	Amphibious Objective Area
AOR	Area of Responsibility
APS	Afloat Planning System
ASARS	Advanced Synthetic Aperture Radar System
ASPT	Advanced Strike Planning Tool
ATACC	Advanced Tactical Air Command Central
ATACMS	Army Tactical Missile System
ATO	Air Tasking Order
AWACS	Airborne Warning and Control System
BAT	Brilliant Anti-Tank
BDA	Bomb Damage Assessment
C^2	Command and Control
C^3	Command, Control, and Communications
C^3I	Command, Control, Communications, and Intelligence
C^4I	Command, Control, Communications, Computers, and Intelligence
CATF	Commander, Amphibious Task Force
CCM	Counter-Countermeasures
CENTCOM	Central Command
CEP	Circular Error Probable
CFE	Conventional Force Reduction in Europe
CHAALS	Communications High-Accuracy Airborne Location System
CINC	Commander-in-Chief
CLF	Commander, Landing Force
CMT	Critical Mobile Target
CONUS	Continental United States
CTAPS	Contingency TACS Automated Planning System
DMA	Defense Mapping Agency
DoD	Department of Defense
DODIIS	Department of Defense Intelligence Information System
DR	Directorate of Requirements
DSB	Defense Science Board
DSP	Defense Support Program
ECM	Electronic Countermeasures
EO/IR	Electro-optical/Infrared
ETUT	Enhanced Tactical User's Terminal
EUCOM	European Command
EW	Electronic Warfare

FARRP	Forward Area Rearming and Refueling Point
FCC	Fleet Command Center
FER	Force Exchange Ratio
FEWS	Follow-on Early Warning System
FLOT	Forward Line of Own Troops
FOFA	Follow-On Forces Attack
GAO	Government Accounting Office
GES	Ground Entry Station
GPS	Global Positioning System
GSM	Ground Station Module
HF	High Frequency
HUMINT	Human Intelligence
IDS	Interdiction/Strike
IFFN	Identification, Friend, Foe, or Neutral
IGB	Inter-German Border
IMINT	Imagery Intelligence
IOC	Initial Operational Capability
IR	Infrared
J-6	Directorate of C^4
JCS	Joint Chiefs of Staff
JDAM	Joint Direct Attack Munition
JFACC	Joint Forces Air Component Commander
JFC	Joint Force Commander
JOTS	Joint Operational Tactical Systems
JPI	Joint Precision Interdiction
JSIPS	Joint Services Imagery Processing System
JSOW	Joint Stand-Off Weapon
JSTARS	Joint Surveillance Target Attack Radar System
JTF	Joint Task Force
JTFC	Joint Task Force Commander
JTIDS	Joint Tactical Information Distribution System
Km	Kilometer(s)
LANTIRN	Low Altitude Navigation and Targeting Infrared for Night
MACCS	Marine Air Command and Control System
MAGTF	Marine Air-Ground Task Force
MASINT	Measurement and Signature Intelligence
MC&G	Mapping, Charting & Geodesy
MIMIC	Millimeter (Wave) Integrated Circuit
MLRS	Multiple Launch Rocket Systems
MSS	Mission Support System
MTI	Moving Target Indicator
NATO	North Atlantic Treaty Organization
NMS	National Military Strategy
NRT	Near Real-Time

NTCSA	Navy Tactical Command System Afloat
NTM	National Technical Means
OJCS	Organization of the Joint Chiefs of Staff
OSD	Office of the Secretary of Defense
P^3I	Pre-planned Product Improvement
PGM	Precision Guided Munition
RSTA	Reconnaissance, Surveillance and Target Acquisition
SACEUR	Supreme Allied Commander Europe
SAM	Surface-to-Air Missile
SAR	Synthetic Aperture Radar
SCDL	Surveillance and Control Data Link
SHAPE	Supreme Headquarters, Allied Powers Europe
SIGINT	Signals Intelligence
SLAM	Stand-off Land Attack Missile
SQL	Standard Query Language
SSM	Surface-to-Surface Missile
TAC	Tactical Air Command
TACAIR	Tactical Air
TACC	Tactical Air Command Center
TACS	Tactical Air Control System
TAMPS	Tactical Aircraft Mission Planning System
TCAC	Technical Control and Analysis Center
TENCAP	Tactical Exploitation of National Capabilities
TERPES	Tactical Electronic Reconnaissance Processing and Evaluation System
TLAM	Tomahawk Land Attack Missile
TRADOC	Training and Doctrine Command
TRE	Tactical Receive Equipment
TSCM	Tomahawk Strike Coordination Module
UAV	Unmanned Aerial Vehicle
UHF	Ultra High Frequency
USA	United States Army
USAF	United States Air Force
USEUCOM	United States European Command
USMC	United States Marine Corps
USMTF	U.S. Message Text Format
USN	United States Navy
VHF	Very High Frequency
VHSIC	Very High Speed Integrated Circuits
WAS	Wide Area Surveillance